NASA

Aeronautical Engineering
A Continuing Bibliography with Indexes

NASA SP-7037 (96)
May 1978

National Aeronautics and Space Administration

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AERONAUTICAL ENGINEERING

A Continuing Bibliography

Supplement 96

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in April 1978 in

- *Scientific and Technical Aerospace Reports (STAR)*
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INTRODUCTION

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This supplement to *Aeronautical Engineering -- A Continuing Bibliography* (NASA SP-7037) lists 448 reports, journal articles, and other documents originally announced in April 1978 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*

The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles.

Each entry in the bibliography consists of a standard bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged in two major sections, *IAA Entries* and *STAR Entries,* in that order. The citations, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* and *STAR*, including the original accession numbers from the respective announcement journals. This procedure, which saves time and money, accounts for the slight variation in citation appearances.

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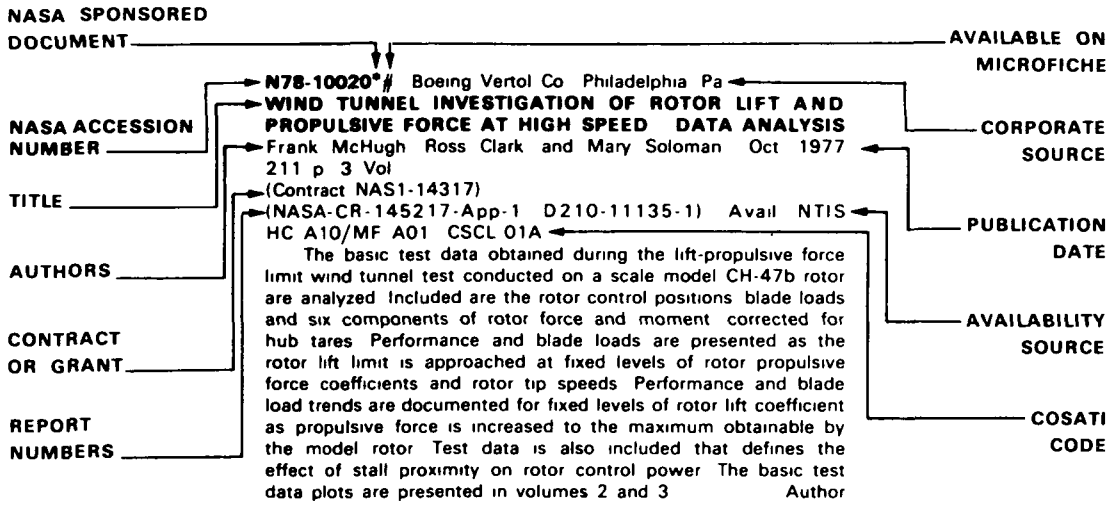

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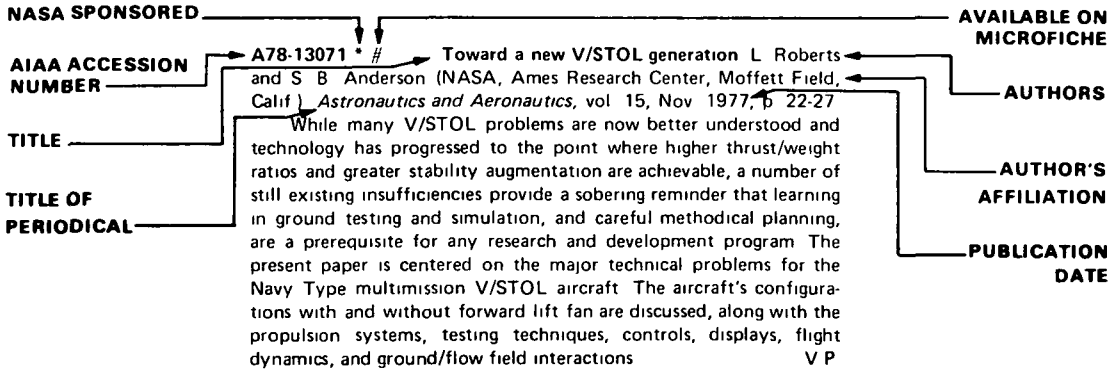

AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 96)

MAY 1978

IAA ENTRIES

A78-20627 # **Detection of sensor failure and output reconstruction for aircraft engine controls** W R Wells (Wright State University, Dayton, Ohio) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala., Jan 16-18, 1978, Paper 78-4* 7 p 11 refs

In this work, the problem of the detection of output sensor failure and corresponding output reconstruction for application to aircraft engine control is discussed The requirements of modern engine control to regulate engine variables to achieve satisfactory transient and steady-state engine performance are better achieved by this reconstruction The detection strategy discussed is that accomplished through the application of Bayesian hypothesis testing to the sensor output records This technique requires statistical information which is generated by a bank of Kalman filters the by-product of which is a reconstruction of the failed sensor states Simulated numerical examples are used to demonstrate the detection and reconstruction capability of the algorithm (Author)

A78 20632 * # **Calculation of unsteady transonic flows using the integral equation method** D Nixon (NASA, Ames Research Center, Moffett Field, Calif.) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala., Jan 16-18, 1978, Paper 78-13* 12 p 13 refs

The basic integral equations for a harmonically oscillating airfoil in a transonic flow with shock waves are derived, the reduced frequency is assumed to be small The problems associated with shock wave motion are treated using a strained coordinate system The integral equation is linear and consists of both line integrals and surface integrals over the flow field which are evaluated by quadrature This leads to a set of linear algebraic equations that can be solved directly The shock motion is obtained explicitly by enforcing the condition that the flow is continuous except at a shock wave Results obtained for both lifting and nonlifting oscillatory flows agree satisfactorily with other accurate results (Author)

A78-20647 # **Aerodynamic heating to the hypersonic research aircraft, X-24C** R D Neumann, J L Patterson, and N J Sliski (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala., Jan 16-18, 1978, Paper 78-37* 11 p

The paper discusses the aerodynamic heating environment sustained by the X 24C aircraft evaluated from ground test data and from engineering design techniques including computer solutions appropriate for the preliminary design process The paper shows that through proper evaluation of the recovery factor, data from hypersonic tunnels can be brought into agreement The data show that the lower surface is not directly predictable by strip theory and that unexpected flow distortions occur near the centerline, that the fuselage sides and strake regions require careful attention to specification of streamline origin and careful analyses of the data to assure turbulent flow in the experiment, that unpredictable hot streaks emanate from the strake-body juncture at low angles of attack, and that the upper surface is a highly unpredictable region of separated, high energy, vortical flow (Author)

A78-20648 * # **Study of heat sink thermal protection systems for hypersonic research aircraft.** W A Vahl and C L W Edwards (NASA, Langley Research Center, High-Speed Aerodynamics Div., Hampton, Va.) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala., Jan 16-18, 1978, Paper 78-38* 12 p 7 refs

The feasibility of using a single metallic heat sink thermal protection system (TPS) over a projected flight test program for a hypersonic research vehicle was studied using transient thermal analyses and mission performance calculations Four materials, aluminum, titanium, Lockalloy, and beryllium, as well as several combinations, were evaluated Influence of trajectory parameters were considered on TPS and mission performance for both the clean vehicle configuration as well as with an experimental scramjet mounted From this study it was concluded that a metallic heat sink TPS can be effectively employed for a hypersonic research airplane flight envelope which includes dash missions in excess of Mach 8 and 60 seconds of cruise at Mach numbers greater than 6 For best heat sink TPS match over the flight envelope, Lockalloy and titanium appear to be the most promising candidates (Author)

A78-20651 * # **A review of NASA's propulsion programs for civil aviation** W L Stewart (NASA, Lewis Research Center, Cleveland, Ohio), H W Johnson (NASA, Aeronautical Propulsion Div., Washington, D C), and R J Weber (NASA, Lewis Research Center, Mission Analysis Branch, Cleveland, Ohio) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala., Jan 16-18, 1978, Paper 78-43* 14 p 19 refs

Five NASA engine-oriented propulsion programs of major importance to civil aviation are presented and discussed Included are programs directed at exploring propulsion-system concepts for (1) energy-conservative subsonic aircraft (improved current turbofans, advanced turbofans, and advanced turboprops), (2) supersonic cruise aircraft (variable-cycle engines), (3) general aviation aircraft (improved reciprocating engines and small gas turbines), (4) powered-lift aircraft (advanced turbofans), and (5) advanced rotorcraft These programs reflect the opportunities still existing for significant improvements in civil aviation through the application of advanced propulsion concepts (Author)

A78-20652 # **Trends and research opportunities in air-breathing propulsion** B Quinn (USAF, Office of Scientific Research, Washington, D C) *American Institute of Aeronautics and Astro-*

nautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-44 10 p 9 refs

The dramatic improvement in jet engine performance is illustrated with the aid of a graph which shows that the thrust to-weight ratio has doubled, approximately, every fifteen years Structural improvements are partly related to advances in materials sciences Engines during the early forties were made almost entirely from conventional steels, stainless steel and aluminum were first used during the late forties, alumínum began to be displaced by titanium in the mid-fifties, and in the mid-sixties the superalloys began to play a dominant role and large by-pass ratio fans increased the relative importance of titanium Recent trends are related to the introduction of composites Attention is also given to trends concerning turbine inlet temperatures, higher through flows, lower specific fuel consumption, and the increasing cost of advanced technology Research opportunities considered are related to fluid mechanics, structural and material mechanics, combustion chemistry, the devel opment of resin matrix composite materials, and mathematics G R

A78-20663 # **The analysis of wing-body combinations at moderate angles of attack** N Uchiyama, R P Mikkilineni, and J M Wu (Tennessee, University, Tullahoma, Tenn) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-62* 7 p 10 refs Grant No DAAG29 77-G 0108

A computational scheme is developed to predict the flow over wing-body combinations at moderate angles of attack and the results of computation are presented for two different wing body combinations The wing is represented by a system of discrete nonintersecting vortex lines Each vortex line in the wake is composed of a series of straight finite segments and a semi-infinite segment The body is represented by a system of source/sink elements distributed on the surface of the body The effect of lifting nose is taken into account by a horseshoe vortex system, the strength and the location of which are based on the empirical relations The basic unknowns in the problem are the strengths of the vortex elements and the source/sink elements, and the direction of the vortex elements in the wake The problem is solved using an iterative approach Numerical results are presented for two wing body combinations The shape of the trailing vortex sheet is shown at different stations along the body (Author)

A78-20664 # **Normal-force and pitching-moment coefficients of wing-body combinations at very high angles of attack** D Nikolitsch (Messerschmitt-Bolkow-Blohm GmbH, Munich, West Germany) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan. 16-18, 1978, Paper 78-63* 10 p 19 refs

A method has been developed to calculate normal force and pitching moment of wing-body combinations at angle of attack up to 40 deg in the subsonic Mach-number range The body is treated according to Wardlaw's multi-vortex model, which has been improved by using a more realistic representation of free vortices The exposed wing is calculated with the aid of the Gersten's nonlinear lifting surface theory The mutual interference is considered partially by the slender-body theory and partially by taking into account the induced velocities Comparisons between theory and tests show good agreement (Author)

A78-20683 * # **Temperature distributions and thermal stresses in a graded zirconia/metal gas path seal system for aircraft gas turbine engines** C M Taylor (NASA, Lewis Research Center, Cleveland, Ohio, Leeds University, Leeds, England) and R C Bill (NASA, Lewis Research Center, U S Army, Propulsion Laboratory, Cleveland, Ohio) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-93* 11 p 5 refs

A78-20684 # **Relating take off gross weight and mission requirements for geometrically optimized aircraft.** M K Greenway (USAF, Washington, D C) and S J Koob (USAF, Institute of Technology, Wright-Patterson AFB, Ohio) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-98* 9 p 8 refs

The method of latin squares was applied to a three-dimensional mission space for a typical ground attack mission profile and independently to a three-dimensional design space to select input conditions for an aircraft sizing program For each mission, the output take-off-gross-weights (TOGW) and corresponding design points determined a quadratic polynomial for TOGW in the three design variables by least squares regression analysis The minimum TOGWs corresponding to each of the thirteen selected mission points were then determined and these were fit by a quadratic polynomial in the three mission variables The result is a simple algebraic relationship between mission requirements and TOGW for geometrically optimized fighter aircraft In a second application of these methods, two engine variables were included in the design space (Author)

A78-20685 # **Computational transonic airfoil design in free air and a wind tunnel** V Shankar, N D Malmuth (Rockwell International Science Center, Thousand Oaks, Calif), and J D Cole (California, University, Los Angeles, Calif) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-103* 9 p 11 refs Contract No F44620-6 C-0044

A computational inverse procedure for transonic airfoils in which shapes are determined supporting prescribed pressure distributions, is presented The method uses the small disturbance equation, and a consistent analysis-design differencing procedure at the airfoil surface This avoids the intermediate analysis design-analysis iterations The effect of any openness at the trailing edge is taken into account by adding an effective source term into the far field A systematic expansion procedure which models the far field for solid tunnel walls is presented along with some design results for the associated boundary conditions and those for a free field (Author)

A78-20686 * # **Transonic wing analysis using advanced computational methods** P A Henne (Douglas Aircraft Co , Long Beach, Calif) and R M Hicks (NASA, Ames Research Center, Moffett Field, Calif) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16 18, 1978, Paper 78-105* 10 p 9 refs

This paper discusses the application of three-dimensional computational transonic flow methods to several different types of transport wing designs The purpose of these applications is to evaluate the basic accuracy and limitations associated with such numerical methods The use of such computational methods for practical engineering problems can only be justified after favorable evaluations are completed The paper summarizes a study of both the small-disturbance and the full potential technique for computing three dimensional transonic flows Computed three dimensional results are compared to both experimental measurements and theoretical results Comparisons are made not only of pressure distributions but also of lift and drag forces Transonic drag rise characteristics are compared Three-dimensional pressure distributions and aerodynamic forces, computed from the full potential solution, compare reasonably well with experimental results for a wide range of configurations and flow conditions (Author)

A78-20687 * # **Laser-velocimeter surveys of merging vortices in a wind tunnel** V R Corsiglia, K L Orloff (NASA, Ames Research Center, Moffett Field, Calif), and J D Iversen (NASA, Ames Research Center, Moffett Field, Calif , Iowa State University of Science and Technology, Ames, Iowa) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-107* 10 p 28 refs

The merger of two vortices was studied with a laser velocimeter designed to measure the two cross-stream components of velocity Measurements were made at several downstream distances in the vortex wake shed by two semispan wings mounted on the wind tunnel walls The velocity data provided well difined contours of cross flow velocity, stream function and vorticity Downstream of the merger point the vorticity was shown to be independent of the

downstream distance for small radii, and at larger radii was dependent on the distance from the wing rather than from the merger point Upstream of the merger point a multicell vorticity pattern was shown (Author)

A78-20701 * # Development and test of an inlet and duct to provide airflow for a wing boundary layer control system D W Gunnarson (Boeing Commercial Airplane Co , Seattle, Wash) and J C McArdle (NASA, Lewis Research Center, Cleveland, Ohio) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-141* 9 p NASA sponsored research

The boundary layer control (BLC) system of the quiet short-haul research airplane (QSRA) requires significant amounts of pressurized airflow for successful operation An inlet and duct were successfully developed which removed airflow from the engine fan duct for the BLC system at or above the required total pressure of 99% of the average fan duct total pressure The design was constrained by the tight space limitations of the QSRA nacelle Potential flow with boundary layer analysis techniques were used as an aid to select the inlet and duct geometries Airflow and total pressure profile data were obtained during development tests (Author)

A78-20702 * # A combined potential and viscous flow solution for V/STOL engine inlets A H Ybarra, W W Rhoades (Vought Corp , Dallas, Tex), and N O Stockman (NASA, Lewis Research Center, Cleveland, Ohio) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-142* 8 p 5 refs

A potential flow routine and a viscous boundary layer routine have been combined into a single routine for estimating the flow in and around subsonic inlets In this combined routine, the viscous flow solution about the inlet body is obtained by adding the viscous displacement thickness to the inlet geometry Combination of the two flow solutions has resulted in cost savings, both in preparation time and in computer time This routine is a useful tool in optimizing lip shapes for V/STOL inlets The method of combining the routine, comparison with NASA test data, and utilization of the routine for V/STOL inlet design are presented (Author)

A78-20704 # The prediction of the performance of low pressure-ratio thrust-augmenter ejectors J A C Kentfield (Calgary, University, Calgary, Alberta, Canada) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-145* 11 p 8 refs

A description is given of a simple procedure for predicting the static performance of low pressure-ratio thrust-augmenter ejectors equipped with hypermixing primary nozzles Such ejectors have been proposed as vertical, and transitional, flight mode thrust augmenters for VTOL aircraft The analysis is based on incompressible flow concepts employed in such a way that the thrust augmentation ratio is evaluated with negligible error Results are presented of a parametric, computer generated, study showing the sensitivity of the optimized performances of a basic ejector configuration to changes in loss coefficients, area ratio and operating conditions It was concluded that it is most important to achieve the highest possible effectiveness of the ejector diffuser and that ejectors with large area ratios are particularly adversely affected by back pressure Comparisons of predictions made using the analytical procedure with experimental results generated by ARL show good agreement (Author)

A78-20705 * # The application of dual fuel /JP-LH2/ for hypersonic cruise vehicles J P Weidner (NASA, Langley Research Center, High-Speed Aerodynamics Div , Hampton, Va) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-149* 8 p 6 refs

The possibility of utilizing jet fuel (JP) stored primarily in the wings of hydrogen-fueled hypersonic cruise vehicles has been evaluated and compared to the performance of all hydrogen-fueled aircraft Parametric investigations of wing loading, thrust-to-weight ratio, payload size and vehicle size are presented Results indicate improvements in performance for a wide range of potential payload sizes, particularly when in-flight refueling of the JP fuel is considered as a means of increasing range and mission flexibility (Author)

A78-20706 * # An aerodynamic analysis of several hypersonic research airplane concepts from M = 0 2 to 6 0 J A Penland, J L Dillon, and J L Pittman (NASA, Langley Research Center, High-Speed Aerodynamics Div , Hampton, Va) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan. 16-18, 1978, Paper 78-150* 12 p 21 refs

Several conceptual hypersonic research airplanes, designed within the constraints of a B-52 launch aircraft, have been studied experimentally and analytically at Mach numbers from 0 2 to 6 0 Vehicles built to these criteria for Mach 6 cruise were shown to be feasible, if careful attention was paid to the low speed lift, drag, and high angle of attack stability to assure successful landings and transonic pitch angle maneuvers The integrated scramjet engine drag was high at subsonic speeds and appears to be constant with Reynolds number The variable geometry airfoil used previously to improve directional stability was shown to be equally adaptable to the improvement of longitudinal stability The vortex lattice theory gave good subsonic predictions of lift, drag due to lift, and pitching moments Wind tunnel tests must be relied on for the drag at zero lift, trim, static margins and lateral-directional stability The Gentry Hypersonic Arbitrary Body Program gave good predictions of the trends of lift, drag, and pitching moments with angle of attack at Mach numbers above 3, but the level of the values were not consistently predicted No currently available theory or program gave accurate predictions of directional stability or dihedral effects at hypersonic speeds (Author)

A78-20707 # Viscous thin airfoil theory and the Kutta condition J E Yates (Aeronautical Research Associates of Princeton, Inc , Princeton, N J) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-152* 8 p 17 refs Contract No N00014-76-C-0576

The linearized thin airfoil problem is formulated for viscous incompressible fluids, and the viscous counterpart of the classical integral equation of thin airfoil theory is derived It is shown that for any Reynolds number, however large, the Cauchy singularity in the inviscid kernel is replaced by a much weaker logarithmic singularity Plausible arguments for the uniqueness of solution of the integral equation are given An asymptotic solution of the viscous airfoil equation is developed for high Reynolds number As Reynolds number tends to infinity, the viscous solution tends to the inviscid solution obtained by invoking the Kutta condition The Reynolds-number correction to the Kutta condition or the lift curve slope is found to be much greater than boundary-layer thickness effects calculated with the inviscid parallel shear-flow boundary-layer model For Reynolds number between one and ten million, the reduction in lift curve slope is approximately 20 percent and offsets the increase due to the geometric thickness of the airfoil (Author)

A78-20708 * # Subsonic vortex-flow design study for slender wings J E Lamar (NASA, Langley Research Center, Hampton, Va) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-154* 10 p 11 refs

A theoretical study describing the effects of spanwise camber on the lift dependent drag of slender delta wings having leading-edge-vortex-flow is presented The earlier work by Barsby, using conical flow, indicated that drag levels similar to those in attached flow could be obtained This is reexamined and then extended to the more practical case of nonconical flow by application of the vortex-lattice method coupled with the suction-analogy and the recently developed Boeing free-vortex-sheet method Lastly, a design code is introduced which employs the suction analogy in an attempt to define 'optimum' camber surfaces for minimum lift dependent drag for vortex flow conditions (Author)

A78-20709 # **The prediction of two dimensional airfoil stall progression** L W Gross (McDonnell Aircraft Co , St Louis, Mo) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-155* 12 p 24 refs

A generalized boundary condition potential flow calculation method has been combined with a momentum integral boundary layer method and a base flow theory of separation to predict airfoil viscous inviscid interference up to and beyond stall The resultant program considers laminar and turbulent separation and is, therefore, applicable to thin or thick airfoil stall The calculated flow field includes the airfoil and the separation bubble recombination region behind the airfoil Calculated pressure distributions and integrated values for lift are compared to measurements for several airfoils demonstrating different types of stall The comparisons show a good prediction of the viscous interference effects (Author)

A78-20710 # **An analysis method for the viscous flow over circulation-controlled airfoils** F A Dvorak (Analytical Methods, Inc , Bellevue, Wash) and R J Kind (Carleton University, Ottawa, Canada) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-157* 11 p 24 refs Contract No N00600-76-C-1494

A method developed for the analysis of the incompressible viscous flow over circulation-controlled airfoils is described A surface vorticity method is used to solve the inviscid portion of the flow and a combination of integral and finite-difference methods is used to calculate the development of the viscous layers An iterative process is used to arrive at final solutions which satisfy an appropriate trailing-edge condition and incorporate the interaction between the viscous and potential regions of the flow Comparisons between calculated and experimental results show good agreement for surface pressure distributions and lift coefficients over a range of blowing momentum coefficient from 0 to 0 12 (Author)

A78-20713 * # **Steady and unsteady transonic flow** H L Seegmiller, J G Marvin, and L L Levy, Jr (NASA, Ames Research Center, Moffett Field, Calif) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-160* 15 p 20 refs

An investigation of the transonic flow over a circular arc airfoil was conducted to obtain basic information for turbulence modeling of shock-induced separated flows and to verify numerical computer codes which are being developed to simulate such flows The investigation included the employment of a laser velocimeter to obtain data concerning the mean velocity, the shear stress, and the turbulent kinetic energy profiles in the flowfield downstream of the airfoil midchord where the flow features are more complex Depending on the free-stream Mach number, the flowfield developed was either steady with shock-wave-induced separation extending from the foot of the shock wave to beyond the trailing edge or unsteady with a periodic motion also undergoing shock-induced separation The experimental data were compared with the results of numerical simulations in which a computer code was employed that solved the time dependent Reynolds' averaged compressible Navier-Stokes equations G R

A78-20716 # **Experimental observations of wall interference at transonic speeds** R F Starr (ARO, Inc , Propulsion Wind Tunnel Facility, Arnold Air Force Station, Tenn) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-164* 10 p 6 refs

Lift and downwash interferences on the high aspect ratio (AR) ONERA calibration configuration have been isolated from other variables such as tunnel flow quality, effective Reynolds number, and model distortion under load which are present in comparative wind tunnel data The lift interference on the ONERA configuration was found to be related to the model to tunnel span ratio and is highly nonlinear in normal force at transonic speeds Fighter and lifting body configurations were also studied These lower aspect ratio configurations (AR less than 4) were found to be much less sensitive to wall interference A family of curves which can be used to estimate lift and pitching moment interference at transonic speeds is presented, and an empirical dependency of lift interference on AR squared is suggested (Author)

A78-20717 # **Experimental investigation of support interference on an ogive cylinder at high incidence** W E Dietz, Jr and M C Altstatt (ARO, Inc , Propulsion Wind Tunnel Facility, Arnold Air Force Station, Tenn) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-165* 8 p 6 refs

A wind tunnel test was conducted to determine the support and tunnel wall interference on an ogive-cylinder model at high angles of attack in transonic flow The model was supported by either a base-mounted sting or a strut attached to the leeside of the model The strut support acted as a splitter plate and generally reduced the normal-force coefficient, whereas the sting support increased the normal-force coefficient slightly The support interference diminished with increasing Mach number A simple algebraic method of estimating support interference was postulated Two semi empirical methods for calculation of aerodynamic coefficients were compared with test results (Author)

A78-20718 * # **Reynolds number criticality in dynamic tests** L E Ericsson and J P Reding (Lockheed Missiles and Space Co , Inc , Sunnyvale, Calif) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-166* 14 p 48 refs Contracts No NAS8-5338, No NAS8 11238, No NAS8 20354, No NAS8-28130, No NAS8-30652

To extrapolate from subscale wind tunnel tests to full-scale flight is a well-recognized problem It becomes especially critical for present day high performance missiles and aircraft which operate at high angles of attack where separated flow effects often dominate the vehicle aerodynamics The dynamic effects of flow separation *can usually not be simulated at subscale Reynolds numbers This is* illustrated by examples of tests with slender vehicles and high performance aircraft It is shown how analytic means can be developed establishing theoretical relationships between dynamic and static aerodynamic characteristics and how such means make it possible to extrapolate analytically from subscale tests to full-scale flight The roll of future high Reynolds number facilities in establishing such 'analytic extrapolation' tools is discussed (Author)

A78-20719 # **Some applications of a test track for aerodynamic testing.** T A Martin and R A Deep (U S Army, Technology Laboratory, Redstone Arsenal, Ala) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-167* 5 p

The inability of wind tunnels to match flight conditions for large test articles and the high cost and exact position determination difficulties associated with flight tests has led to the use of a high speed track for aerodynamic testing These tests included (1) determining the aeroelastic response of a production wing under high conditions, (2) the aerodynamic effects due to the presence of a large plume, and more recently, (3) the flow field character in the near and far wake of a thrusting rocket The development of these testing techniques as well as test results will be discussed (Author)

A78-20739 * # **Noise transmission into a light aircraft** R Vaicaitis (Columbia University, New York, N Y) and W McDonald *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-197* 14 p 19 refs NASA supported research

An analytical study on noise transmission into a cabin of a twin engine G/A aircraft is presented The solution of the governing acoustic-structural equations of motion is developed utilizing modal expansions and a Galerkin type procedure The exterior noise pressure inputs are taken from available experimental data A direct comparison between theory and experiments on cabin noise levels is given Interior noise reduction by stiffening, mass addition, and

damping treatments is investigated It is shown that a combination of added mass and damping could significantly reduce interior noise levels for this aircraft (Author)

A78-20743 # **An investigation of strut-wall intersection losses** T J Barber (United Technologies Corp , Pratt and Whitney Aircraft Group, East Hartford, Conn) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-205* 9 p 14 refs

A study of the intersection losses associated with the junction of a symmetric airfoil and a planar wall is reported An experimental program, conducted in a low speed air tunnel, provided detailed wake total pressure profiles as well as surface flow visualization photographs which define the overall flow field The behavior of the intersection losses were examined for dependence on flow incidence angle and strut contour It was found that the endwall intersection losses were strongly dependent on the thickness of the incident boundary layer, thick incident boundary layers producing markedly lower losses than very thin incident boundary layers A heuristic model of the flow field, which explains marked differences between the thick and thin boundary layer results, is also presented (Author)

A78-20746 # **The flow about a slender propeller-driven body in a temperature stratified fluid** T F Swean, Jr (STD, Inc , Washington, D C) and J A Schetz (Virginia Polytechnic Institute and State University, Blacksburg, Va) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78 209* 11 p 9 refs ARPA-supported research

An experimental study of the turbulent wake produced by a slender, stern-propeller-driven body in a temperature-stratified fluid is presented The velocity and thermal boundary layers on the body upstream of the propeller are also examined The testing was conducted in a 6 x 6 ft subsonic wind tunnel at a Reynolds number of about 200,000 The temperature stratification was produced by upstream injection of heated air in a manner such that a uniform approach velocity field was retained The temperature variation provided a means of tracing flow development in the near-body region Mean flow velocities, static pressure, flow angularity and mean temperature distributions are reported at specified downstream stations Turbulence data, including temperature fluctuations, are reported The principal effect of the propeller was to induce a more or less rigid rotation immediately downstream of the body No significant increase in mixing rate was observed in the region up until 4 0 body diameters downstream Temperature fluctuation is low across the wake except in the vicinity of the propeller tips where it becomes relatively large The high temperature fluctuation often occurred in regions of low mean temperature gradients (Author)

A78-20755 # **High-frequency approximation for a nonlifting thin airfoil in subsonic flow** A Plotkin (Maryland, University, College Park, Md) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-226* 5 p 10 refs Research supported by the University of Maryland

The problem of high frequency subsonic potential flow past a thin nonlifting airfoil is investigated The unsteadiness in the flow is caused by either harmonic pulsation of the airfoil surface or interaction with an upstream sinusoidal irrotational disturbance Closed-form solutions are obtained for the velocity potential and surface pressure distribution for wavelengths intermediate between the airfoil thickness and chord (Author)

A78-20756 # **Effect of blade loading and thickness on the aerodynamics of oscillating cascades** H Atassi and T J Akai (Notre Dame, University, Notre Dame, Ind) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-227* 11 p 19 refs Grant No AF AFOSR-74-2675

The unsteady aerodynamic forces and moments are calculated for highly loaded cascade blades oscillating about their mean position with constant interblade phase angle in a uniform incompressible flow The results show that the blade thickness and the mean flow incidence have significant effects on both the magnitude and phase of the lift and moment These effects are very sensitive to the interblade phase angle and become stronger with increased cascade stagger For bending oscillations, the effect of thickness increases the aerodynamic damping, while for torsional oscillations it mainly enhances the in-phase component of the rotational moment At constant blade loading, no definite trends of variation of the unsteady aerodynamic forces and moments can be established This indicates a strong coupling between the mean flow incidence and the blade and cascade geometry (Author)

A78-20757 # **Reliable lifting surface solutions for unsteady flow** P F Jordan *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-228* 11 p 12 refs Contract No F44620-73-C-0041

Numerical experimentation has shown that accurate solutions obtained for suitable sets of numbers N squared of finite elements can readily be extrapolated to the limit N tending to infinity and thus to the correct solution for a given wing A method for calculating the required accurate solutions even in the case of unsteady flow has been developed As a sample application, the gust load admittance function is calculated for a set of rectangular wings and, by means of further extrapolation, is presented for all reduced frequencies k and for all aspect ratios in the aspect ratio range between one and infinity Additional sample results presented are flutter coefficients and an admittance value for a chessboard type gust field (Author)

A78-20759 # **Influence of nosetip shape on boundary layer transition in arc heated jets** I Auerbach (Sandia Laboratories, Albuquerque, N Mex) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-235* 8 p

The effect of model shape on the graphite recession rate and boundary-layer transition was studied in an arc jet over the pressure and enthalpy ranges of 0 99-20 7 MPa (9 8-204 atm) and 3416-15640 J/g (1470-6730 Btu/lb), respectively Hemispheric, flat-faced, and conic cylindrical models were used It was found that resistance to transition occurs in the order of flat faced-conic hemispheric shape Evidence of this behavior is provided in terms of the relative ablation rates associated with each shape and the times to transition The differences in resistance to transition are appreciable and suggest that reentry vehicles would benefit with respect to nosetip shape change by changing from the conventional hemispheric shape to a conic or, preferably, a flat-faced configuration (Author)

A78 20762 * # **Measurements of noise produced by flow past lifting surfaces** J M Kendall (California Institute of Technology, Jet Propulsion Laboratory, Physics Section, Pasadena, Calif) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78 239* 12 p 12 refs Contract No NAS1-12185

Wind tunnel studies have been conducted to determine the specific locations of aerodynamic noise production within the flow field about various lifting-surface configurations The models tested included low aspect ratio shapes intended to represent aircraft flaps, a finite aspect ratio NACA 0012 wing, and a multi element wing section consisting of a main section, a leading edge flap, and dual trailing edge flaps Turbulence was induced on the models by surface roughness Lift and drag were measured for the flap models Hot wire anemometry was used for study of the flap-model vortex roll up Apparent noise source distributions were measured by use of a directional microphone system, located outside the tunnel, which was scanned about the flow region to be analyzed under computer control These distributions exhibited a diversity of pattern, suggesting that several flow processes are important to lifting-surface noise production Speculation concerning these processes is offered (Author)

A78-20763 * # **EBF noise suppression and aerodynamic penalties** L J McKinzie, Jr (NASA, Lewis Research Center, Cleveland, Ohio) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78 240* 13 p 15 refs

Acoustic tests were conducted at model scale to determine the noise produced in the flyover and sideline planes at reduced separation distances between the nozzle exhaust plane and the flaps of an under-the-wing (UTW) externally blown flap (EBF) configuration in its approach attitude Tests were also made to determine the noise suppression effectiveness of two types of passive devices which were located on the jet impingement surfaces of the configuration In addition, static aerodynamic performance data were obtained to evaluate the penalties produced by these suppression devices Broadband low frequency noise reductions were achieved by reducing the separation distance between the nozzle and flaps However, mid and high frequency noise was produced which exceeded that of the reference configuration Two passive noise suppression devices located on the flaps produced moderate to large noise reductions at reduced separation distances Consideration of the static aerodynamic performance data obtained for the configura tions tested suggests that specific broadband noise suppression characteristics may be obtained through a trade-off with aero dynamic performance penalties by the careful selection of suppres sion devices (Author)

A78-20765 # **On some singular acoustic signatures observed in the cockpit of a twin engined jet aircraft** S M Ramachandra (Hindustan Aeronautics, Ltd , Bangalore, India) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-242* 7 p

An investigation was conducted concerning the origin of a noise with unusual characteristics which was perceived by test pilots during production flight tests involving a twin-engined jet fighter aircraft The noise was characterized by the pilots as 'grinding' It was found in the investigation that the noise originated at the tips of compressor blades in cases in which an excessive clearance existed between the rotor blade tips and the compressor casing Approaches for ensuring the uniformity of rotor blade tip clearances are, therefore, needed to eliminate or alleviate the considered noise phenomena According to the physical model proposed, the noise is produced by vortices which are shed from the blade tips if an excessive clearance exists between the rotor blade tip and the compressor casing G R

A78-20769 # **A study on the mechanism of compressor surge due to inlet pressure disturbances** Y Sugiyama (Cincinnati, University, Cincinnati, Ohio, Japan Defense Agency, Technical Research and Development Institute, Tokyo, Japan), A Hamed, and W Tabakoff (Cincinnati, University, Cincinnati, Ohio) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-246* 12 p 17 refs

This paper presents an analysis of the mechanism of compressor surge in a turbojet engine due to pressure disturbances at the air intake inlet The computational model simulating the whole engine from the air intake to the exhaust nozzle, can predict surge hammer, as well as compressor surge cycles The computed results show that a significant correlation exists between the compressor surge and the magnitude and duration of the pressure disturbances (Author)

A78-20770 # **Large amplitude shock wave motion in two dimensional transonic channel flows** T C Adamson, Jr , A F Messiter, and M S Liou (Michigan, University, Ann Arbor, Mich) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-247* 9 p 5 refs Contract No N0019-76 C 0435

Two dimensional unsteady transonic channel flow with a shock wave is considered for the slowing varying time regime Pressure oscillations, introduced downstream of the shock wave, cause the shock wave to oscillate, the case considered is that where the shock is forced upstream of the throat, disappears, and then reappears as the downstream pressure first increases and then decreases The subsequent shock wave motion consists of oscillations either about the throat or about the original steady flow shock position, depending upon parametric relationships developed in the analysis These two cases and the dividing case are illustrated with example calculations (Author)

A78-20771 * # **Effect of wind turbulence and shear on landing performance of jet transports** E F Blick, J McCarthy (Oklahoma, University, Norman, Okla), R R Bensch, and N R Sarabudla *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan. 16-18, 1978, Paper 78-249* 10 p Contract No NAS8-31377

Computer simulations of a Boeing 727 class aircraft landing in turbulence were developed by programming the longitudinal aircraft equations of motion into a digital computer with various input values of vertical and horizontal wind speeds Turbulent wind data was fed to the computer in one-second intervals The computer computed in one-second intervals the aircraft speed, altitude, horizontal distance traveled, rate-of-descent, pitch attitude, glide path angle (from edge of runway) and elevator angle All computer runs were made in the 'stick-fixed' mode The RMS values of altitude and velocity perturbations (from equilibrium) were found to be large when horizontal wind gusts had sinusoidal components at or near the phugoid (long period) frequency Maximum RMS altitude deviations occurred when the vertical wind had sinusoidal components which were 1/10 to 1/5 of the phugoid frequency When real wind data (obtained from NCAR Queen Air) were used as input winds good correlations were found to exist between RMS velocity perturbations and both horizontal and vertical wind shears (Author)

A78-20774 * # **Preliminary comparison of model and prototype wakes** E Logan, Jr (Arizona State University, Tempe, Ariz) and D W Camp (NASA, Marshall Space Flight Center, Atmospheric Sciences Div , Huntsville, Ala) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-254* 11 p 9 refs

Velocity and turbulence profiles previously measured in the wake of a long building 3 2 m high, located in the field, transverse to the wind and in an atmospheric boundary layer several hundred meters thick are compared with wake profiles at corresponding longitudinal stations for a scale model of the building located in a large meteorological wind tunnel having a boundary layer thickness of 0 61 m to assess the accuracy of full scale wake profile predictions based on model tests Results are presented which show that disparities in nondimensional profiles result from differences in relative depth of logarithmic layers and in surface conditions (Author)

A78-20781 # **Future aviation turbine fuels** A V Churchill, C L Delaney, and H R Lander (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan. 16-18, 1978, Paper 78-268* 7 p 6 refs

This paper discusses an Air Force program which is being conducted to establish the properties of an aviation turbine fuel which will result in adequate fuel availability for the Air Force at an acceptable cost Results of recent processing studies on alternative hydrocarbon sources from coal and shale oil are presented, together with combustor studies directed to determining the effects of property variations on combustor performance, durability and level of harmful emissions Also, results of a recent survey are given showing projected increases in turbine fuel availability resulting from turbine fuel property changes A projection of the chemical and physical properties of the future Air Force aviation turbine fuel is presented (Author)

A78-20782 # **Air Force research and development activities related to aircraft fire protection** B P Botteri, G W Gandee, and R G Clodfelter (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-269* 9 p 6 refs

Selected aspects of the current Air Force research and development program pertaining to aircraft fire protection are reviewed These include development of computerized fire and explosion vulnerability assessment models development of advanced engine and a fuel tank fire test simulators for model refinement and advanced protection techniques evaluation, development of advanced fire and explosion protection subsystems, and development of non-flammable hydraulic fluid for future aircraft applications Where appropriate, projected performance comparisons of advanced versus state-of-the-art protection techniques are included (Author)

A78-20783 # **Antimisting fuel kinematics related to aircraft crash landings** A San Miguel (U S Naval Weapons Center, China Lake, Calif) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-270* 8 p 12 refs U S Department of Transportation Contract No FA76WA1-589

An approximate analysis is presented to quantitize kinematic behavior of antimisting Jet A fuel in an airstream representative of survivable aircraft crash landings Antimisting fuel data were generated from a fuel expulsive airfoil placed in an airstream adjacent to a pulsing propane flame Measurements of burning front velocities and accelerations were obtained from a camera located within the airfoil These data were used in the analysis to predict the diameter, shear stress, and shearing strain rate of the average particle of antimisting fuel in the airstream under the airfoil A description is given of the airflow-airfoil apparatus in the context of its simulation of crash landing conditions The feasibility of using antimisting agents to suppress a fuel fire during a crash landing is evaluated (Author)

A78-20791 # **Numerical solution for airfoils near stall in optimized boundary fitted curvilinear coordinates** J K Hodge (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) and A L Stone (USAF, Acquisition Logistics Div , Wright-Patterson AFB, Ohio) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-284* 12 p 22 refs

Boundary-fitted curvilinear coordinate systems are optimized for viscous flows about arbitrary airfoils at angles of attack such that boundary-layer-dependent grid systems for high Reynolds numbers are generated efficiently The grid systems are utilized in implicit finite-difference solutions Solution of a one-dimensional model equation is compared with the theoretical solution The unsteady Navier-Stokes equations are solved for the incompressible flow around a cylinder and around NACA airfoils approaching stall The predicted flows around a NACA 6412 airfoil near stall at Reynolds numbers of 40,000 and 200,000 are compared with the experimental observations obtained in a smoke tunnel (Author)

A78-20792 # **Application of skin technology to turbine blades.** J Wortmann, K Schweitzer (Motoren- und Turbinen-Union Munchen GmbH, Munich, West Germany), H Sprenger, and E Erben (M A N Neue Technologie, Munich, West Germany) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-285* 11 p 6 refs Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt Contract No 01-QV-276-ZK-SNA-SLN

The paper presents a technological process which makes it possible to improve blade materials at zero gravity conditions at a minimum of expenditure of energy and material By this process the properties of blades manufactured conventionally at 1-g conditions with cooling air holes or without are improved by remelting and controlled solidification at zero gravity conditions To preserve the shape of the blades in the gravity process the deformative surface tensions arising in the melting operation are contained by a thin, 10 to 100 micron skin of a material exhibiting a high melting point Experiments made at 1-g conditions on Al2O3 coated IN 100 test specimens showed that a skin giving the requisite configurational and chemical stability could be achieved The results of these experiments indicate that this technology is generally feasible (Author)

A78-20795 # **Three-dimensional hypersonic gas flow past a thin wing (O prostranstvennom obtekanii tonkogo kryla giperzvukovym potokom gaza)** A I Golubinskii and V N Golubkin (Tsentral'nyi Aerogidrodinamicheskii Institut, Zhukovskii, USSR) *Akademiia Nauk SSSR, Doklady,* vol 234, June 11, 1977, p 1032 1034 8 refs In Russian

Formulas are derived for a low-aspect ratio thin wing at angle of attack in hypersonic flow Its leeward side is in aerodynamic shadow, while the windward side receives the main portion of aerodynamic loading Shock layer theory, with a small parameter epsilon defined by density ratio for a strong shock, is used to analyze flow past the windward surface Consideration is given to cases of a basic 'Newtonian' flow and of a flow with conical symmetry (the formulas obtained in this latter case are analogous to those for a delta wing) B J

A78-20802 # **Use of the singular perturbation method to investigate automatic control systems (O primenenii metoda singuliarnykh vozmushchenii pri issledovanii sistem avtomaticheskogo upravleniia)** B V Viktorov (Moskovskii Aviatsionnyi Institut, Moscow, USSR) *Akademiia Nauk SSSR, Doklady,* vol 236, Sept. 11, 1977, p 296-299 14 refs In Russian

The approaches of order reduction and complete splitting are applied to special cases of automatic control systems, whose partial motions occur with variable intensity Consideration is given to nonlinear systems, to linear systems in the absence of external excitation, and to linear systems in the presence of external excitation As an example, attention is paid to autopilot-stabilization of pitch angle B J

A78-20845 # **Calculation of the flow past a fuselage of arbitrary configuration at low velocities (K raschetu obtekaniia fiuzeliazha proizvol'noi formy pri malykh skorostiakh)** L A Maslov and V P Iushin *TsAGI, Uchenye Zapiski,* vol 7, no 1, 1976, p 1 8 In Russian

Maslov (1966) has proposed a method for calculating potential flows past three-dimensional bodies of arbitrary configuration, which differs from the generally accepted method developed by Hess and Smith (1964) in that the basic integral equation is solved by a different method Maslov's modification provides savings in computer time without impairing accuracy In the present paper, a further improvement to the method is introduced The cylindrical coordinates, which place certain constraints of the configuration of the body, are replaced by a Cartesian system for defining the surface and by a special curvilinear system of coordinates for use in the computations Using this method with a BESM 6 computer, it proved possible to solve a problem involving 1280 design points at one half of a fuselage having a vertical symmetry plane V P

A78-20849 # **Approximate method of calculating the lifting force and the longitudinal moment of an airfoil section at low velocities with allowance for viscosity (Priblizhennyi metod rascheta pod'emnoi sily i prodol'nogo momenta profilia s uchetom viazkosti pri malykh skorostiakh)** M A Brutian and Ia M Serebriiskii *TsAGI, Uchenye Zapiski,* vol 7, no 1, 1976, p 33 39 5 refs In Russian

A78-20850 # **Turbulent boundary layer on a moving surface (Turbulentnyi pogranichnyi sloi na podvizhnoi poverkhnosti)** A S Ginevskii, G N Emal'ianova, and A V Kolesnikov *TsAGI, Uchenye Zapiski,* vol 7, no 1, 1976, p 40-50 13 refs In Russian

An integral and a numerical method are proposed for calculating the turbulent boundary layer on a moving surface (flap) in the presence of a longitudinal pressure gradient under conditions of monotonic velocity profiles The integral method is a modification of Fediaevskii's et al (1973) integral method (for calculating turbulent boundary layers in an incompressible fluid) to include an airfoil moving faster or slower than the oncoming flow The numerical method employs a more complex eddy viscosity model in which allowance is made for intermittence at the external side of the boundary layer and for the interaction of molar and molecular effects at the internal side of the boundary layer V P

A78-20857 # **Calculation of the flow of a rarefied gas past a plate of infinite span (Raschet obtekaniia plastiny beskonechnogo razmakha potokom razrezhennogo gaza)** A I Erofeev and V A Perepukhov *TsAGI, Uchenye Zapiski*, vol 7, no 1, 1976, p 102 106 13 refs In Russian

The Monte Carlo method is applied to the calculation of the aerodynamic characteristics of a plate of infinite span situated at an angle of attack in a low-density hypersonic flow The influence of the plate temperature, the molecular interaction law, and the internal molecular degrees of freedom on the aerodynamic characteristics is evaluated Calculations are carried out for Mach numbers of 5 and 10 It is shown that allowance for internal degrees of freedom leads to a better agreement with the experiment V P

A78-20864 # **Solving the problem of numerical construction of a model of similar rigidity to the initial structure as a problem of quadratic programming (Reshenie zadachi o chislennom postroenii modeli, podobnoi po zhestkosti iskhodnoi konstruktsii, kak zadachi kvadratichnogo programmirovaniia)** V A Tranovich and Iu F Iaremchuk *TsAGI, Uchenye Zapiski*, vol 7, no 1, 1976, p 147-151 In Russian

A78-20866 # **Application of the finite element method to the stability analysis of triangular plates in supersonic flow (Primenenie metoda konechnykh elementov dlia issledovaniia ustoichivosti treugol'nykh plastin v sverkhzvukovom potoke)** V A Vysloukh, V P Kandidov, and S S Chesnokov *TsAGI, Uchenye Zapiski*, vol 7, no 1, 1976, p 160-164 8 refs In Russian

A78-20867 # **A formulation of the problem of the minimum-drag wing (Ob odnoi postanovke zadachi o kryle minimal'nogo soprotivleniia)** M N Kogan and V D Perminov *TsAGI, Uchenye Zapiski*, vol 7, no 2, 1976, p 1 7 In Russian

A variational problem is formulated and solved for determining the profile of minimum drag in supersonic and hypersonic flow under the conditions that the distribution of the given lift along the profile is such that for each profile element it is equal to the weight of the profile element For both the supersonic and hypersonic case, this additional condition is shown to lead to a certain increase in drag and a change in the shape of the optimal profile However, it also leads to a reduction in the weight of the wing structure P T H

A78-20879 # **Optimum schedule for replacement of aircraft system parts under incomplete information on their reliability (Optimal'noe raspisanie zamen elementov sistem samoleta pri nepolnoi informatsii ob ikh nadezhnosti)** R F Avramchenko *TsAGI, Uchenye Zapiski*, vol 7, no 2, 1976, p 95-104 In Russian

A schedule for part replacement is defined, which ensures a maximum guaranteed mean time of uninterrupted service life of an aircraft system The reliability of each element is characterized by a mean operating time and its dispersion An analytic solution of the corresponding minimax problem is constructed by a method based on Pontriagin's maximum principle For each act of replacement, the optimal time interval in which a replacement should be made and also the intervals between replacements are determined A strong dependence of the effectiveness of the system on the dispersion of the operating time of the parts is noted P T H

A78-20880 # **Taking structural and technological constraints into account in the design of maximum-stiffness load bearing structures (Ob uchete konstruktivnykh i tekhnologicheskikh ogranichenii pri proektirovanii silovykh konstruktsii maksimal'noi zhestkosti)** E K Lipin *TsAGI, Uchenye Zapiski*, vol 7, no 2, 1976, p 105-113 6 refs In Russian

The paper gives a formulation and solution of the problem of optimizing a complex structure using the condition of minimum strain energy and satisfying strength and stiffness requirements in the presence of structural and technological constraints The problem is formulated as one of classical variational calculus with conditional extremum The inequalities expressing the constraints on the magnitudes of the geometric parameters are replaced by equalities by the method of Valentine P T H

A78-20881 # **Rational parameters of reinforced panels operating under conditions of unsteady heating (O ratsional'nykh parametrakh podkreplennykh panelei, rabotaiushchikh v usloviiakh nestatsionarnogo nagreva)** S N Ivanov *TsAGI, Uchenye Zapiski*, vol 7, no 2, 1976, p 114 120 6 refs In Russian

A formulation and method of solution are given for the problem of selecting rational parameters of reinforced panels operating under conditions of intense aerodynamic heating The panels are subjected to time varying transverse loads which do not depend on the coordinates, a longitudinal load, and bending moments at the ends A panel is also subjected to unsteady aerodynamic heating The temperature field is computed numerically, and the stress field of the strut is calculated with the aid of the hypothesis of plane sections The problem is solved by nonlinear programming methods, in particular, the method of penalty functions As an example, the parameters of a steel panel of a heat shield reinforced by stringers are computed P T H

A78-20882 # **Taking into account the effect of elasticity of the structure on the longitudinal short-period motion of an aircraft (Ob uchete vliianiia uprugosti konstruktsii na prodol'noe korotkoperiodicheskoe dvizhenie samoleta)** Iu A Kublin and V I Chubarov *TsAGI, Uchenye Zapiski*, vol 7, no 2, 1976, p 121-130 In Russian

A method of estimating the effect of elastic strains on the longitudinal short period motion of an aircraft is proposed From the general equations for the elastic vibrations of an aircraft, a truncated system of equations is obtained, describing with sufficient accuracy for engineering purposes the dynamics of short-period motion Redistribution of aerodynamic forces due to elasticity of the structure is accounted for in the truncated system by corrections to the lift coefficient and the longitudinal moment coefficient Elastic strains are determined by the Ritz variational method P T H

A78-20883 # **Approximate method of calculating subsonic compressible flows past a lifting wing profile (Priblizhennyi metod rascheta dozvukovykh szhimaemykh techenii okolo nesushchego krylovogo profilia)** A A Shagaev *TsAGI, Uchenye Zapiski*, vol 7, no 2, 1976, p 131-135 9 refs In Russian

A78-20886 # **Interaction of a shock wave with an entropy layer (Vzaimodeistvie udarnoi volny s entropiinym sloem)** A N Minailos *TsAGI, Uchenye Zapiski*, vol 7, no 2, 1976, p 149-153 6 refs In Russian

A straight through finite-difference scheme was used to study the interaction of a shock wave with a flat high-entropy jet both in the free supersonic flow and in the flow at the body surface Several cases are analyzed, and situations characterized by direct reflection of a wave are examined The advantages and limitations of the straight-through finite difference scheme are discussed M L

A78-20889 # **Pressure distribution over sharp-nosed cones situated at angles of attack from 0 to 10 degrees in supersonic flow (Raspredelenie davleniia na ostrykh konusakh pri uglakh ataki alpha = 0-10 deg v sverkhzvukovom potoke)** P G Leutin *TsAGI, Uchenye Zapiski*, vol 7, no 2, 1976, p 163-166 8 refs In Russian

An empirical method is proposed for determining the pressure distribution over cones with half-angles ranging from 10 to 30 degrees, situated at incidence in supersonic flow The method is based on the use of a similarity rule for sharp-nosed cones at zero incidence in combination with a pressure coefficient that varies linearly with the angle of attack in the meridional plane V P

A78-20895 # **Calculation of the mean flow characteristics at the inlet to the air intake located under a delta wing (Raschet osrednennykh kharakteristik potoka na vkhode vozdukhozabornika, ustanovlennogo pod treugol'nym krylom)** A P Bazzhin and I M Filimonov *TsAGI, Uchenye Zapiski*, vol 7, no 3, 1976, p 10-17 In Russian

The paper presents calculated values for the mean Mach number, the contraction ratio, the full pressure recovery coefficient, and the downwash and upwash averaged for flow at the inlet to the air intake located under an 80 deg delta wing for free stream Mach numbers from 3 to 6 and attack angles from 0 to 10 deg Flow around the wing with separation at the leading edge is examined The dependence of the parameters on the position of the air intake inlet plane is studied M L

A78-20900 # **The basic characteristics of the variation of aerodynamic parameters in the transition region at hypersonic flow velocities (Osnovnye zakonomernosti izmeneniia aerodinamicheskikh kharakteristik v perekhodnoi oblasti pri giperzvukovykh skorostiakh potoka)** V N Gusev, T V Klimova, and V V Riabov *TsAGI, Uchenye Zapiski*, vol 7, no 3, 1976, p 47 54 13 refs In Russian

The paper reports an experimental study of aerodynamic parameters at hypersonic flow velocities The aerodynamic parameters of bodies of simple form in the transition region between the region of free molecular flow and the region where the gas flow is like a continuum were investigated The basic characteristics of the variation of these parameters during the change of basic similarity criteria are analyzed and discussed M L

A78-20902 # **Approximate wind-tunnel simulation of the dynamics of a system composed of a body with a trailing cable (Priblizhennoe modelirovanie dinamiki sistemy tros-telo v aerodinamicheskoi trube)** V I Valiaev *TsAGI, Uchenye Zapiski*, vol 7, no 3, 1976, p 65-71 In Russian

In the present paper, a criterion is derived for simulating, in a subsonic wind tunnel, the dynamic instability of trailing cable with an end load in incompressible flow The criterion is obtained from an analysis of equations of perturbed motion and the corresponding boundary conditions, derived in a simplified two-dimensional formulation The mathematical model is seen to describe the essential features of the phenomenon, while the necessary corrections, resulting from the influence of neglected factors, can be determined in the course of the experiment V P

A78-20903 # **Economical method for calculating unsteady temperature fields in thin-walled aircraft structures (Ekonomichnyi metod rascheta nestatsionarnykh temperaturnykh polei v tonkostennykh aviatsionnykh konstruktsiiakh)** G N Zamula and S N Ivanov *TsAGI, Uchenye Zapiski*, vol 7, no 3, 1976, p 72 79 5 refs In Russian

The numerical engineering method proposed in the present paper for calculating unsteady temperature fields in plane sections of thin-walled aircraft structures is based on the use of the implicit scheme of the balance method in combination with difference factorization The method can be extended to systems containing two layer struts connected laterally in such a way that a thermal resistance appears at the interface Adapted to a digital computer, the method provides substantial time savings as compared to programs based on an explicit scheme V P

A78-20905 # **Velocity profiles in the Laval nozzle throat for uniform compressible swirling flow (Profili skorostei v minimal'nom sechenii sopla Lavalia pri odnorodnom vintovom techenii gaza)** N N Slavianov *TsAGI, Uchenye Zapiski*, vol 7, no 3, 1976, p 91 96 10 refs In Russian

In the present paper, a special case of Laval-nozzle flow - a uniform swirling flow in which the radial velocity component and its derivative are negligible along the flow - is analyzed The axial and circumferential velocity profiles in the nozzle throat are calculated, along with the threshold values of swirl intensity, at which separated and reciprocating circulation zones do not arise in the flow core The analysis indicates that swirl induced phenomena are more distinct in gases having large specific heat ratios V P

A78-20906 # **Inviscid supersonic flow about a thin rectangular plate (Neviazkoe sverkhzvukovoe techenie u tonkoi priamougol'noi plastiny)** A N Minailos *TsAGI, Uchenye Zapiski*, vol 7, no 3, 1976, p 97-102 6 refs In Russian

In the present paper, a modified Lax-Wendroff scheme is applied to the calculation of the flow pattern about a rectangular plate situated at an angle of attack of 30 degrees in a supersonic flow A solution is obtained, neglecting flow separation from the lateral edges The flow pattern (shock waves and vortices) are plotted against the angle of attack at a freestream Mach number of 5 The pressure distribution over the upper and lower plate (wing) surfaces is diagrammed V P

A78-20913 # **Rearrangement of the flow between a pair of bodies, one of which is situated in the other's wake, in supersonic flow (Perestroika techeniia mezhdu paroi tel, odno iz kotorykh raspolozheno v slede drugogo, pri sverkhzvukovom obtekanii)** V S Khlebnikov *TsAGI, Uchenye Zapiski*, vol 7, no 3, 1976, p 133-136 7 refs In Russian

The critical spacing between two bodies situated one behind the other is understood to mean the spacing at which the common separation zone of the two bodies breaks down In the present paper, a relationship between the critical spacing and a certain correlation parameter is derived The relationship can be used to determine the spacing (between two bodies in supersonic flow) at which a rearrangement of the flow structure between the bodies will set in V P

A78-20915 # **Simulation of the flight conditions in the ionosphere (K voprosu o modelirovanii uslovii poleta v ionosfere)** B E Zhestkov, A Ia Knivel', and A I Omelik *TsAGI, Uchenye Zapiski*, vol 7, no 3, 1976, p 142-147 12 refs In Russian

The plasma component in a weakly-ionized hypersonic free molecule nitrogen stream is analyzed The analysis leads to a probe design that is suitable for analyzing the ion and electron components in the presence of a neutral gas in the plasma, even when the neutral gas intensity exceeds that of the plasma component by several orders of magnitude A flow with a plasma component is shown to provide satisfactory simulation of the forces acting on a vehicle orbiting in the ionosphere V P

A78-20917 # **Determination of the stress-strain state in the end region of a stress-raiser rib (Otsenka napriazhennogo sostoianiia v kontsevoi zone prervannogo stringera)** E K Lipin and V M Frolov *TsAGI, Uchenye Zapiski*, vol 7, no 3, 1976, p 152-155 In Russian

The problem of the stress-strain state of a stress raiser rib does not possess an exact solution In the present paper, the stress-strain state is determined by approximating the representation of the stress function in the form of the product of two functions obtained from the condition of minimum complementary strain energy V P

A78-20918 # **Upgrading the carrying capacity of stretched panels with a stress-raiser rib by the technique of strain-compensating holes (Povyshenie nesushchei sposobnosti rastianutykh panelei s prervannym stringerom metodom razgruzhaiushchikh otverstii)** A N Kulikov, V F Kut'inov, S K Kusheverskii, and I N Panchenko *TsAGI, Uchenye Zapiski*, vol 7, no 3, 1976, p 156 159 In Russian

A78-20920 # **The effect of blunting the leading edge of a delta wing on its aerodynamic characteristics during supersonic flight (Vliianie skrugleniia perednei kromki treugol'nogo kryla na ego aerodynamicheskie kharakteristiki pri sverkhzvukovykh skorostiakh poleta)** V V Keldysh and R I Shteinberg *TsAGI, Uchenye Zapiski*, vol 7, no 4, 1976, p 1-8 5 refs In Russian

Wind tunnel tests were performed to study the effect of blunting the subsonic leading edge of a delta wing on the aerodynamic characteristics of the wing in transonic and supersonic flow Models of delta wings with blunt and with sharp leading edges were tested and it was determined that a blunt subsonic leading edge for a blunting radius to thickness ratio of not greater than 0 25 does not necessarily lead to a reduction in the lift-drag ratio of the wing For a supersonic blunt leading edge, increasing its sweep angle from 60 to 80 deg is accompanied by a considerable increase in maximum lift-drag ratio B J

A78-20921 # **Supersonic flow near a thin trapezoidal wing (Sverkhzvukovoe techenie u tonkogo trapetsievidnogo kryla)** A N Minailos *TsAGI, Uchenye Zapiski*, vol 7, no 4, 1976, p 9-17 5 refs In Russian

A numerical method developed by Minailos (1976) is used to study the steady supersonic conical flow past a thin trapezoidal wing, with a lateral-edge sweep angle varying from 45 to 90 deg The analysis, based on the use of isosurfaces, is applied to the investigation of flow profiles for cases of shock waves attached to and detached from the lateral edge Results are presented for a freestream Mach number of 5 and an angle of attack range of 5-25 deg B J

A78-20930 # **Use of the polynomial method to calculate the parameters of the stabilized maneuver of an elastic aircraft (Primenenie metoda mnogochlenov k raschetu parametrov ustanovivshegosia manevra uprugogo samoleta)** G A Amir'iants and V G Bun'kov *TsAGI, Uchenye Zapiski*, vol 7, no 4, 1976, p 88-94 In Russian

An algorithm is developed making it possible to extend the polynomial method to the computation of some of the aerodynamic characteristics of an elastic aircraft, performing a stabilized maneuver The aeroelastic flutter analysis is performed on the basis of stiffness, inertial and aerodynamic matrices Universal expressions are obtained for deformations of the aircraft and for rudder performance for cases of lateral and longitudinal maneuver B J

A78-20932 # **Use of a fast Fourier transformation and the Monte Carlo method to calculate repeatibility of load and fatigue damage of aircraft structural elements under vibration excited by external stationary random loads (Primenenie bystrogo preobrazovaniia Fur'e i metoda Monte Karlo dlia rascheta povtoriaemosti nagruzok i ustalostnogo povrezhdeniia elementov aviatsionnykh konstruktsii pri kolebaniiakh ot statsionarnoi sluchainoi vneshnei nagruzki)** G V Vronskii *TsAGI, Uchenye Zapiski*, vol 7, no 4, 1976, p 102 110 12 refs In Russian.

A78-20933 # **Two new correlation dependencies for parameters of flow on a plane delta wing (Dve novye korreliatsionnye zavisimosti dlia parametrov techeniia na ploskom treugol'nom kryle)** A P Bazzhin *TsAGI, Uchenye Zapiski*, vol 7, no 4, 1976, p 111-114 5 refs In Russian

The integral relation method is used to obtain a numerical solution for the problem of the supersonic flow of an inviscid nonheat conducting gas past the under surface of a delta wing Angle of attack varied in the range 30-60 deg and freestream Mach number varied in the range 4-10 Two new correlation dependencies were obtained as a result of the numerical solution for the transverse velocity gradient at the symmetry axis of the wing and for shock wave detachment from the wing in the symmetry plane B J

A78-20949 # **Effect of the thickness of profile and trailing edge on the flow field and the aerodynamic characteristics of a low-aspect-ratio delta wing at M = 3 (Vliianie tolshchiny profilia i zadnei kromki na pole techeniia i aerodinamicheskie kharakteristiki treugol'nogo kryla malogo udlineniia pri chisle M-3)** A N Minailos *TsAGI, Uchenye Zapiski*, vol 7, no 5, 1976, p 9 14 In Russian

A78-20951 # **Flow visualization in the region of intersection of aerodynamic surfaces (Vizual'noe issledovanie kartiny techeniia v oblasti peresecheniia aerodinamicheskikh poverkhnostei)** A G Ereza and E Kh Orlovskaia *TsAGI, Uchenye Zapiski*, vol 7, no 5, 1976, p 26 31 In Russian

The paper presents wind tunnel results on the visualization of boundary layer flow in the region of intersection of aerodynamic surfaces in the transonic range (M = 0 6-0 9) and at high Reynolds numbers (about 13 x 10 to the 6th) The following variants of connection of the half-profile tested with the wind tunnel wall were considered (1) the connection slit was totally eliminated and the interface radius was about 2 mm, (2) the slit was totally eliminated and the interface radius was 10 mm, (3) the slit was not eliminated, and (4) the slit was eliminated beneath the panel for the whole length of the wind tunnel wall, and there was through flow in the interface Oil film pictures of the flow lead to the conclusion that the boundary layer flow in the presence of a positive pressure gradient is sensitive to connection interface conditions as well as to through flow in the interface B J

A78-20953 # **Characteristics of the jet acceleration of a flow to hypersonic speeds (Osobennosti struinogo razgona potoka do giperzvukovykh skorostei)** V N Gusev and Iu V Nikol'skii *TsAGI, Uchenye Zapiski*, vol 7, no 5, 1976, p 44-52 6 refs In Russian

The theory of jet acceleration to hypersonic speeds, involving pressure recovery and the generation of a shock wave system (hanging, reflected and Mach disk) in an inviscid supersonic underexpanded flow in a duct, is reviewed Consideration is given to the degree of nonuniformity of the flow field in the axial region of a strongly underexpanded jet, along with methods for reducing this nonuniformity The flow of a strongly underexpanded jet in a duct with sudden expansion is examined in the framework of employing jet acceleration in wind tunnel experiments B J

A78-20966 # **Hypersonic gas flow past a flat delta wing (Obtekanie ploskogo treugol'nogo kryla giperzvukovym potokom gaza)** V N Golubkin *TsAGI, Uchenye Zapiski*, vol 7, no 6, 1976, p 1-10 11 refs In Russian

The attached hypersonic flow at incidence past a flat small aspect-ratio delta wing is analyzed, and a method of solving the direct problem is proposed The method is based on the assumption that a portion of the wing in the region of the symmetry plane is a conical stream surface, and that the stream function varies along this surface It is shown that using this assumption and two solutions of the equation describing the shape of the shock, it is possible to construct a compression shock that transfers continuously from a rectilinear to a curvilinear shock V P

A78-20970 # **Calculation of the Laval-nozzle flow by a modified Lax Wendroff method of second-order accuracy (Raschet techeniia v sople Lavalia metodom ustanovleniia vtorogo poriadka tochnosti)** A P Mazurov *TsAGI, Uchenye Zapiski*, vol 7, no 6, 1976, p 35-40 9 refs In Russian

The mixed inviscid nonheat conducting gas flow in a two dimensional symmetrical Laval nozzle with a low-radius-of-curvature throat is analyzed The flow fields and flow coefficients are calculated by a modified Lax-Wendroff method, using Mac Cormack's finite-difference scheme Flow coefficients obtained for convergence and divergence angles of 30 and 15 degrees, respectively, and for throat radii of curvature of 0 35, 0 55, 0 75, and 1 00 are found to correlate well with computations by the method of asymptotic expansions, and to compare satisfactorily with experimental data V P

A78-20971 # **Construction of a mathematical model of a jet engine for analyzing transient flows (K postroeniiu matematicheskoi modeli silovoi ustanovki VRD dlia issledovaniia nestatsionarnykh rezhimov)** V T Grin' *TsAGI, Uchenye Zapiski,* vol 7, no 6, 1976, p 41-49 11 refs In Russian

A complete system of equations describing two-dimensional transient flows of an ideal gas is used as a basis to construct a mathematical jet-engine model, including an air intake, a compressor, a combustion chamber, a nozzle, and control elements The model describes the transient phase of engine operation, the duration of which is defined by the flow dynamics The model can be used to analyze dynamic processes and to gain insight into air intake/compressor interaction For illustration, it is applied to the analysis of a transient process arising from the interaction between a temperature wave and the steady supersonic flow at air-intake inlet section V P

A78-20973 # **Determination of airfoil lift from pressure measurement at the test section walls in a subsonic wind-tunnel (Opredelenie pod'emnoi sily profilia po izmereniiu davlenii na stenkakh rabochei chasti dozvukovoi aerodinamicheskoi truby)** V S Gavrisev, V M Gadetskii, and A S Mozol'kov *TsAGI, Uchenye Zapiski,* vol 7, no 6, 1976, p 57 62 In Russian

The theory of a method for measuring the lift of an airfoil section is outlined Measurements are made in a subsonic rectangular closed throat wind tunnel, the lift being determined with a pneumatic integrator from the mean value of the static pressure at the top and bottom walls of the test section A single manometer reading is sufficient for determining the lift of an airfoil section in the case of attached flow V P

A78-20984 # **Rational arrangement of the structural and load-bearing elements of the wing with allowance for certain aerodynamic requirements (O ratsional'noi konstruktivno-silovoi komponovke kryla s uchetom nekotorykh aerodinamicheskikh trebovanii)** V I Biriuk and V M Frolov *TsAGI, Uchenye Zapiski,* vol 7, no 6, 1976, p 134-138 In Russian

It is shown that the effect of reduced torsional wing strain for transverse loads and corresponding aerodynamic conditions can be obtained not only by increasing the general rigidity of the structure but by a choice of a rational scheme of structural and load-bearing elements The procedure for obtaining this rational arrangement involves use of a parameter which characterizes the static stability for wing strain in air flow M L

A78-21003 **The tropospheric and stratospheric composition perturbed by NO/x/ emissions of high-altitude aircraft** H Hidalgo (Institute for Defense Analyses, Arlington, Va) and P J Crutzen (National Center for Atmospheric Research, Boulder, Colo) *(American Geophysical Union and American Meteorological Society, Non Urban Troposphere Composition Symposium, Hollywood, Fla , Nov 10-12, 1976) Journal of Geophysical Research,* vol 82, Dec 20, 1977, p 5833-5866 31 refs FAA-supported research

The effect of aircraft flight altitude on atmospheric ozone has been studied by using NO(x) emitted from hypothetical fleets operating individually in an altitude range between 10 8 and 18 km The study is based on the use of an empirical two-dimensional (2-D) photochemical model of the troposphere and stratosphere An important characteristic of this model is the incorporation of the methane oxidation reactions, which produce ozone in the troposphere and lowest stratosphere The 2-D model reproduces several characteristics of the latitudinal and seasonal variations in ozone and other species Other characteristics of the model are (1) the numerical simulation of water vapor data in the natural troposphere and stratosphere and (2) the inclusion of Rayleigh scattering for wavelengths longer than 300 nm in the determination of photodissociation rates Results are presented in terms of ozone column changes as a function of latitude and season for the assumed (not forecast) NO(x) injection rates for each fleet In general, the results show (1) a small (less than 1%) enhancement in the ozone column due to the methane oxidation reactions in regions of heavy traffic for injections at 10 8 km, (2) almost no effect on the ozone column for injections at 14 5 km, and (3) a decrease in the ozone column due to the NO(x) catalytic cycle for SST injections at 18 km (Author)

A78-21020 # **Lateral stability of a light aircraft during landing (Statecznosc boczna w czasie dobiegu ladujacego samolotu sportowego)** Z Goraj, J Maryniak, Z Paturski, and M Zlocka (Warszawa, Politechnika, Warsaw, Poland) *Mechanika Teoretyczna i Stosowana,* vol 15, no 4, 1977, p 501 516 20 refs In Polish

A five-degree-of-freedom model of a light aircraft running along the ground after landing is proposed Unsteady lateral forces acting on the tires are modeled as linear functions of sideslip, camber angle, and steady aerodynamic forces The equations of motion are derived with the aid of the Boltzmann-Hamel equations for holonomic systems The dominating influence of two forms of natural vibration is revealed high-frequency snaking of the aircraft nose section and low-frequency yaw P T H

A78-21084 **Effect of a conical break of delta-wings on the aerodynamic characteristics** A L Gonor, V V Kravets, and A I Shvets *(Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* Nov-Dec 1976, p 100-104) *Fluid Dynamics,* vol 11, no 6, July 1977, p 904-908 11 refs Translation

The paper reports the results of experimental investigations of the aerodynamical coefficients and pressure on the windward side of delta wings with a conical break A comparison was also made between the aerodynamic quality parameters of delta wings with conical break and of wing-cone models with caret-shaped symmetric arrangement at a Mach number of 5 96 P T H

A78-21090 **Experimental investigation of the characteristics of small-sized nozzles** V A Butenko, Iu P Rylov, and V P Chikov *(Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* Nov-Dec 1976, p 137-140) *Fluid Dynamics,* vol 11, no 6, July 1977, p 936-939 7 refs Translation

The momentum and discharge coefficients were determined experimentally for nozzles with boundary layer displacement thickness less than or equal to 1 mm in the range of Reynolds numbers from 200 to 7,000 The high degree of accuracy of the formula of Kuluva and Hosack (1971) for determining the discharge coefficient has been confirmed A formula is proposed for determining the momentum coefficient as a result of approximating the experimental data in the Reynolds number range studied P T H

A78-21093 **Effect of nozzle shape on characteristics of three-dimensional subsonic and supersonic flows** V M Dvoretskii *(Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* Nov-Dec 1976, p 147-151) *Fluid Dynamics,* vol 11, no 6, July 1977, p 948-952 10 refs Translation

The characteristics of three dimensional subsonic and supersonic flows of an inviscid and nonheat-conducting gas in nozzles of complex shape were analyzed The investigation was based on numerical integration of a system of gas dynamics equations with the aid of monotonic finite difference schemes of first-order accuracy Flow in the whole nozzle channel, including subsonic and supersonic regions, was computed, and the results show how a suitable choice of nozzle profile shape can affect the distribution of the nonuniformity characteristics of the flow P T H

A78-21098 **Computation of the base pressure in ejector nozzles of different length with zero coefficient of ejection** N L Efremov and R K Tagirov *(Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* Nov Dec 1976, p 164 166) *Fluid Dynamics,* vol 11, no 6, July 1977, p 966-968 Translation

A78-21132 **Entropy layer in two-dimensional flows** N E Ermolin *(PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki,* Nov Dec 1976, p 38 48) *Journal of Applied Mechanics and Technical Physics,* vol 17, no 6, July 1977, p 779-787 10 refs Translation

Steady plane and axisymmetric hypersonic flows of a perfect gas behind a shock wave are analyzed, assuming that the angle between the shock wave and the velocity vector of the uniform oncoming flow is small everywhere with the exception of a small region at the apex of the body. A solution beyond this region is obtained, by the method of matched asymptotic expansions, for a shock whose generatrix varies according to a (near) power law at the apex The asymptotic solution obtained yields an implicit relationship between steady two-dimensional gas flows with entropy layer and unsteady one-dimensional flows V P

A78-21133 **Semiempirical theory of the generation of discrete tones by a supersonic underexpanded jet flowing over an obstacle** V N Glaznev and V S Demin *(PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki,* Nov-Dec 1976, p 49-55) *Journal of Applied Mechanics and Technical Physics,* vol 17, no 6, July 1977, p 787-793 18 refs Translation

An elementary theory of the mechanism of the Hartmann air jet generator is proposed It is assumed that oscillations develop in a one-dimensional resonant cavity in the form of a subsonic flow between a Mach disk and a wall The acoustic waves emitted from the cavity, having reached the nozzle exit section, generate disturbances at the jet boundary These disturbances grow during propagation downstream and are damped at the wall The pressure pulse thus generated at the wall will lead to self-oscillations if the pulse is strong enough and is phase correlated with the cavity oscillations V P

A78-21205 # **Stress-strain state of simply-supported three-layer trapezoidal plates (Napriazhenno deformirovannoe sostoianie svobodno opertykh trekhsloinykh trapetsievidnykh plastin)** A V Vestiak and E A Khvilon (Moskovskii Aviatsionnyi Institut, Moscow, USSR) *Problemy Prochnosti,* Sept 1977, p 37-41 5 refs In Russian

An approximate method is proposed for calculating the stress-strain state of thin elastic three-layer trapezoidal plates subjected to a uniformly distributed transverse load The method is applicable to symmetric and unsymmetric trapezoids Results obtained by the method are shown to be in close agreement with an exact solution obtained by Timoshenko and Woinowsky Krieger V P

A78-21219 # **Perturbing forces in the hydrodynamic interaction of thin-blade cascades in a potential flow (Vozbuzhdaiushchie sily pri gidrodinamicheskom vzaimodeistvii reshetok tonkikh profilei v potentsial'nom potoke)** V E Saren and V A Iudin *Problemy Prochnosti,* Sept 1977, p 104-109 In Russian

The paper deals with the theoretical determination of the perturbing forces generated by the interaction of two blade rings in a potential incompressible flow (quasi-stationary formulation of the problem) The results of the present analysis make it possible to determine some characteristic properties of the perturbing forces For illustration, the relative level of the perturbing forces is calculated for the hydrodynamic interaction of neighboring blade rings in an axial-flow compressor V P

A78-21374 # ***Elastic deformations of rapidly-rotating prismatic mirrors (Uprugie iskazheniia bystrovrashchaiushchikhsia prizmaticheskikh zerkal)*** V S Trachuk (Vsesoiuznyi Nauchno Issledovatel'skii Institut Optiko-Fizicheskikh Izmerenii, Moscow, USSR) *Zhurnal Nauchnoi i Prikladnoi Fotografii i Kinematografii,* vol 22, Sept Oct 1977, p 335-342 8 refs In Russian

The article discusses the elastic deformations of rapidly-rotating prismatic mirrors often used in photorecording instruments Equations are developed for calculating such deformation, noting the influence of rotor parameters and the material characteristics of the mirror surfaces It is shown that the most effective mirror optimization, yielding minimal deformation, is achieved by consideration of the mirror configuration and the magnitude of the Poisson coefficient of the mirror material The optimization of 6, 7, and 8 sided mirrors is discussed with regard to their manufacture on the basis of widely used construction materials S C S

A78-21632 # **An experimental study of three-dimensional characteristics of propeller wakes under stalling conditions** D Favier, J Rebont (CNRS, Paris, France), and C Maresca (CNRS, Paris, Aix-Marseille I, Universite, Marseille, France) *ASME, Transactions, Series I - Journal of Fluids Engineering,* vol 99, Dec 1977, p 745-752 18 refs

The three-dimensional flow field of a four-bladed propeller wake has been investigated by use of an anemometric hot film technique The paper does not deal with the measuring procedure, which has been previously described by the authors, but describes the results obtained for the three-dimensional wake To gain insight into the process by which local blade stalling influences the wake structure, four advance ratios have been investigated The two lower values of the advance ratio correspond to a local blade stalling which first affects the blade tip and grows towards the hub with decreasing values of the advance ratio The resultant velocity profiles of u, v, w in the azimuthal direction are investigated and compared at different advance ratios and at various radii These experimental results reveal that a local flow separation has considerable influence on the three velocity components It is concluded that for an advance ratio with rotor stalling, the flow separation increases the rotational wake speed effect generated by an increasing tangential component u The radial flow diminishes as shown by the v velocity profiles A sharp thickening of the blade wake is also observed from the axial component w (Author)

A78-21635 # **A method for the construction of flow nozzles and wind tunnel contraction sections** R Eichhorn (Kentucky, University, Lexington, Ky) and T S Fox (Institute of Paper Chemistry, Appleton, Wis) *ASME, Transactions, Series I - Journal*

of Fluids Engineering, vol 99, Dec 1977, p 772-774 5 refs NSF Grant No GK-15251

A method is described for forming a flow nozzle whose cross section varies smoothly from one shape to another The flow passage consists of fiber glass cloth saturated with epoxy resin cast in place about an elastic water filled rubber diaphragm An example of such a nozzle, with a circular inlet section and a rectangular exit section was constructed and incorporated in a wind-tunnel design The flow distribution, excluding the exit boundary layer, is uniform to within 0 5 percent The exit boundary layer is laminar and steady and the discharge coefficient is 0 989 (Author)

A78-21838 Design to cost/life cycle costing, Proceedings of the Conference, Washington, D C, November 16-18, 1977 Conference sponsored by the American Institute of Industrial Engineers Edited by D T Newman (Management Education Corp, Santa Monica, Calif) Santa Monica, Calif, Management Education Corp, 1977 845 p $50

Government and industry experience in the management of acquisition programs is discussed, with particular attention given to the impact of life cycle costing on design to cost principles The recent Office of Management and Budget directive on systems acquisition, design to cost guidelines of federal agencies, source selection directives and parametric cost modeling figure in the discussions In addition, tracking of performance versus goals, the trade-off process and cost reduction procedures are considered Case studies involve such problems as development of solar power systems for military bases, and avionics subsystem development J M B

A78-21971 Concerning the relationship between element stability and system stability in wing-truss structure made from elastic and elasto-plastic materials (Uber den zusammenhang von Elementstabilitat und Systemstabilitat von Tragwerken aus elastischem und elastisch-plastischem Werkstoff) W Brocks and K Burth (Berlin, Technische Universitat, Berlin, West Germany) *Forschung im Ingenieurwesen*, vol 43, no 6, 1977, p 190-198 26 refs In German

A finite element method is employed to analyze deformations in elastic materials used for wing-trusses A system of geometric, nonlinear equations is developed, making use of Drucker's postulate in both limited and expanded versions The effect of single unstable elements is examined, as well as branch loading within the framework of the entire system Finally, loading parameters are discussed in terms of stability and plasticity theories D M W

A78-21976 Glass-fiber data bus systems for signal transmission on board (Glasfaser-Bussysteme zur Signalubertragung in Bordnetzen) K Erdel and H Strehl (Siemens AG, Munich, West Germany) *Frequenz*, vol 31, Dec 1977, p 364-368 11 refs In German Research supported by the Bundesministerium der Verteidigung

The organizational forms of avionic networks for flight control applications are examined Difficulties with a decentralized system led to the design of data bus systems Specifications were developed by the U S Air Force (1975) for an aircraft internal time division command/response multiplex data bus It is expected that the copper data bus communications links of the current avionic systems will be replaced in the systems of the next generation by optical glass fiber communication links A study of an experimental system using glass fibers has been conducted by Shannfield and Biard (1976) Advantages of a use of optical communication media include an immunity against electromagnetic interference, the galvanic separation between transmitter and receiver, the impossibility of spark formation, a wide bandwidth, and low weight Attention is given to point to-point glass-fiber connections and glass-fiber data bus systems G R

A78-21989 External interaction of the nuclear EMP with aircraft and missiles C D Taylor (Mississippi State University, Mississippi State, Miss) *IEEE Transactions on Antennas and Propagation*, vol AP-26, Jan 1978, p 64-76 35 refs USAF-supported research

The external coupling of nuclear EMP to metal aircraft and missile structures is discussed, with particular attention given to the cases of the EC-135 and the B 1 aircraft Experimental data for the skin current and charge densities induced on the two types of aircraft are presented, the experiments involve continuous wave testing and the construction of the response to the nuclear EMP through use of Fourier frequency superposition The experimental results are compared with numerical calculations developed on the basis of aircraft models formed by bodies of revolution or intersecting sections of wires J M B

A78-21990 Surface current and charge density induced on aircraft Y M Hwang (Ford Aerospace and Communication Corp, Palo Alto, Calif), L Peters, Jr, and W D Burnside (Ohio State University, Columbus, Ohio) *IEEE Transactions on Antennas and Propagation*, vol AP-26, Jan 1978, p 77-81 13 refs

The usefulness of the geometrical theory of diffraction (GTD) in computing the surface current and charge density induced on aircraft is illustrated This is a high-frequency solution for an arbitrary incident plane wave and fuselage observation points A pattern is presented for an arbitrary incident plane wave as well as a series of frequency and time domain plots for roll plane incidence A 3-dimensional pattern is presented for plane wave incidence (as a function of incidence angle) as well as examples of roll plane results in both the frequency and time domain (Author)

A78-21992 EMP response of aircraft antennas. K S H Lee, L Marin (Dikewood Corp, Los Angeles, Calif), and T K Liu (Science Applications, Inc, Berkeley, Calif) *IEEE Transactions on Antennas and Propagation*, vol AP-26, Jan 1978, p 94-99 22 refs Contracts No F29601 74-C-0010, No F29601-75-C-0120

The responses of aircraft antennas to a broadband electromagnetic wave such as the nuclear electromagnetic pulse (EMP) are analyzed For convenience of analysis the antennas are divided into five classes blades, loops, slots, bowls, and long wires From each class a few specific antennas are selected as examples for detailed discussion For each exemplary antenna the detailed equivalent circuit, input impedance, and effective height at the antenna's connector are given Measurements of input impedance on some antennas are compared with the corresponding calculated results. (Author)

A78-21995 Broad-band analysis of VLF/LF aircraft wire antennas L Marin, K S H Lee (Dikewood Corp, Los Angeles, Calif), and J P Castillo (USAF, Weapons Laboratory, Kirtland AFB, Albuquerque, N Mex) *IEEE Transactions on Antennas and Propagation*, vol AP-26, Jan 1978, p 141 145 9 refs Contract No F29601-76-C-0133

The broad-band response of a VLF/LF dual-wire aircraft antenna is analyzed The impedance properties and the induced currents on the two wires of different lengths are obtained via a superposition procedure in which the original problem is split into two transmission-line (differential-mode current) problems and two antenna (common-mode current) problems Results for the input admittance and short-circuit current of a representative VLF/LF dual-wire antenna are presented (Author)

A78-22078 # Hypersonic flow past a conical wing with detached shock wave at the leading edges (K zadache o giperzvukovom obtekanii V-obraznogo kryla s otsoedinennoi udarnoi volnoi na perednikh kromkakh) N A Ostapenko *Moskovskii Gosudarstvennyi Universitet, Institut Mekhaniki, Nauchnye Trudy*, no 44, 1976, p 21-29 7 refs In Russian

Hypersonic conical flow past a conical wing with detached shock at the leading edge is analyzed The aerodynamic coefficients are calculated, and the dependence of the lift-to-drag ratio on the opening angle of the wing is obtained The analysis reveals a gain in lift to-drag ratio in conical wings with detached shock as compared to that of flat delta wings in hypersonic flow P T H

A78-22079 # **Study of supersonic separated flow past conical wings and inside a right angle (Issledovanie sverkhzvukovogo otryvnogo techeniia pri obtekanii V-obraznykh kryl'ev i vnutri priamogo ugla)** V N Alekseev and A L Gonor *Moskovskii Gosudarstvennyi Universitet, Institut Mekhaniki, Nauchnye Trudy,* no 44, 1976, p 30-35 In Russian

Models of a conical wing representing a control organ and two-sided right angle corners were investigated in Mach 3 wind tunnel tests, where flow on the surfaces was visualized by an oil technique and the flow in transverse planes was observed by the schlieren method The interaction of the characteristic branching shock with the boundary layer was observed Criteria for separation of flow were used to correlate flow data The evolution of the boundary layer displacement thickness was followed P T H

A78-22080 # **Nearly wedge-shaped antisymmetric wing in supersonic flow (Antisimmetrichnoe krylo, blizkoe k klinu, v sverkhzvukovom potoke)** M I Folle *Moskovskii Gosudarstvennyi Universitet, Institut Mekhaniki, Nauchnye Trudy,* no 44, 1976, p 36-42 7 refs In Russian

Supersonic flow past a surface which is nearly a wedge of finite thickness is analyzed under the assumption that the gas velocity behind the attached shock remains supersonic The surface of the wing is centrally symmetric (antisymmetric) when viewed from the direction of the incident flow The mathematical formulation of the problem leads to two infinite chains of integrodifferential equations, which are solved with the aid of the rule of indices The similarity of the solution to that for a symmetric wing is noted P T H

A78-22091 # **Boundary layers in dissipative media (Pogranichnye sloi v dissipativnykh sredakh)** V P Stulov *Moskovskii Gosudarstvennyi Universitet, Institut Mekhaniki, Nauchnye Trudy,* no 48, 1977 79 p 32 refs In Russian

Applications of boundary-layer theory to problems in gas and fluid mechanics that contain small parameters associated with the higher derivatives in the relevant equations are outlined It is noted that such an approach can be used in principle to develop uniformly in the whole region under consideration exact solutions that are in accord with the boundary conditions of the initial problem Emphasis is placed mainly on the zero approximation in fluid- and gas-mechanics problems, and boundary-layer structure in compressible gases, chemically reactive mixtures, and plasmas is studied Regular degeneracy and boundary layers for linear differential equations with a small parameter are investigated along with viscous incompressible fluid flows near perforated and unperforated surfaces Attention is also given to parabolic boundary layers, an evaluation of the terms in the Navier-Stokes equations, the Prandtl equations, boundary-layer corrections in the analysis of a viscous incompressible fluid flow at large Reynolds numbers, shock-wave structure, the relaxation zone behind a shock wave, and the chemical boundary layer in a viscous gas F G M

A78-22108 # **Fatigue of AMg6M sheet with Sprut 5M and VAK coatings in the linear and plane states of stress under high-frequency loads (Ustalost' listovogo materiala AMg6M s pokrytiiami Sprut 5M i VAK pri lineinom i ploskom napriazhennom sostoianiiakh v usloviiakh vysokochastotnoi nagruzki)** R I Stefanov *Problemy Prochnosti,* Oct 1977, p 45, 46 In Russian

A78-22232 **Performance-optimized horizontal-axis wind turbines** R E Wilson and S N Walker (Oregon State University, Corvallis, Ore) In International Symposium on Wind Energy Systems, Cambridge, England, September 7-9, 1976, Proceedings Cranfield, Beds , England, British Hydromechanics Research Association, 1977, p B1 1 to B1 28, X23, Discussion, p X24, X25 17 refs NSF Grant No AER-74-04014-A03

Design procedures for optimum wind turbines is shown to be different from that used for propellers An optimum design generation approach for wind turbines is developed from a modified strip theory that includes tip-loss The approach entails a local optimization of blade element parameters to maximize power output Examples are presented that illustrate the optimum design generation procedure and off-design performance (Author)

A78-22269 **Big fans for the airlines** W Gunston *Shell Aviation News,* no 444 1977, p 28-34

A review of developments in commercial jet engine technology is presented, stressing modifications of low by-pass ratio engines which led to the production of today's engines, having a higher by-pass ratio High by-pass ratio turbofans are especially effective in reducing noise levels and fuel consumption Attention is given to three shaft turbofans, which simultaneously increase thrust and provide improved engine cooling Cost considerations are mentioned, especially in relation to engines in the 10/15 ton class D M W

A78-22347 **Airborne navigation systems** M Hirst *Flight International,* vol 113, Jan 14, 1978, p 110-113

The accuracy of airliner navigation systems has not increased markedly since the late 1960s, but operational flexibility and installation and operating costs have continued to improve Modern area-navigation systems are still not fully utilized The automatic navigation systems fitted to the airliners that fly across oceans have been revolutionized various times over the last few decades The inertial navigation systems (INS) brought great accuracies and lower operating costs About ten years ago triple-INS installations became standard for wide-bodied aircraft At present the dominance of INS is being challenged by very-low-frequency (VLF) aids such as Omega, and VLF communications systems relying on U S Navy transmissions for reference signals Most airlines now prefer dual INS with Omega In the near future the U S could make its long-awaited decision about the deployment of the Navstar GPS (Global Positioning System) This 24-satellite system will have its transmitters in three circular orbits at 10,900 n m altitude G R

A78-22355 **Transonic swirling gas flow through a nozzle** V B Gorskii *(Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* Mar -Apr 1977, p 75-80) *Fluid Dynamics,* vol 12, no 2, Oct 1977, p 226 231 13 refs Translation

The swirling gas flow in the transonic portion of a nozzle is analyzed, assuming that the flow is a steady axisymmetric potential flow and that the gas is inviscid and non-heat-conducting An equation describing swirling potential transonic gas streams is derived and is shown to generalize both the transonic Karman-Falkovich equation and its solution describing continuous nozzle flows V P

A78-22359 **Calculation of nonlinear aerodynamic characteristics of wing of complex planform allowing for nose vortex sheet** V A Aparinov *(Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* Mar -Apr 1977, p 107-111) *Fluid Dynamics,* vol 12, no 2, Oct 1977, p 253-256 Translation

Belotserkovskii's (1968) method, modified by Aparinov et al (1976) is applied to the determination of the characteristics of wings of complex planform The modification of the method makes allowance for the vortex sheet at the nose of delta wings Results of computer-aided calculations for delta wings, small aspect ratio wings with a kinked leading edge, and swept wings are examined It is shown that the method under consideration can be used to determine moments and distributed and total loads on wings, and also to determine flow structures in the form of vortex sheets and velocity vector fields V P

A78-22361 **Experimental investigation of asymmetric Laval nozzles** A B Bobovich, V B Kornilovich, B N Maslov, and A A Shishkov *(Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* Mar Apr 1977, p 123-128) *Fluid Dynamics,* vol 12, no 2, Oct 1977, p 266-271 11 refs Translation

The paper deals with the experimental determination of the magnitude of a transverse force generated in a Laval nozzle due to the asymmetry of the pressure field The nozzles employed included Mach 1 nozzles with subsonic portions of different design, various supersonic nozzles with subsonic portions deviating from the supersonic portion by different angles, and nozzles with axisymmetric supersonic and axisymmetric subsonic portions The behavior of the transverse force is illustrated for each type of nozzle, and expressions approximating the transverse force are derived V P

A78-22364 **Electrical fluctuations in turbulent electrogasdynamic flows** A B Vatazhin, V A Likhter, A M Rushailo, and V I Shul'gin *(Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza,* Mar -Apr 1977, p 148-159) *Fluid Dynamics,* vol 12, no 2, Oct 1977, p 285 295 12 refs Translation

Some processes occurring in turbulent flows containing charged particles are examined It is shown that the presence of charged fuel droplets in jets of aircraft engines leads to electric charge pulsations The problem of determining the turbulence characteristics of jets from electric pulsations measured with electrostatic probes is formulated Laboratory measurements of electric pulsations in actual aircraft-engine jets are described Good correlation between electric and acoustic pulsations is established V P

A78-22551 * # **The effect of ambient conditions on the emissions of an idling gas turbine** C W Kauffman (Michigan, University, Ann Arbor, Mich), A K Subramanian, D W Rogers, and R W Claus *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-3* 13 p 19 refs Grant No NsG-3045

Changes in ambient conditions - pressure, temperature, and humidity - affect the exhaust emissions of a gas turbine engine Such variations must be compensated for during engine certification The results of a test program employing a JT8D-17 combustor are presented which quantize the effect of carefully controlled changes on unburned hydrocarbons, carbon monoxide, and oxides of nitrogen at simulated idle operating conditions Analytical results are given to explain the observed hydrocarbon and carbon monoxide behavior It is shown that for a complete range of possible ambient variations, significant changes do occur in the amount of pollutants emitted by an idling gas turbine (Author)

A78-22553 * # **A split-recoupled-semidirect computational technique applied to transonic flow over lifting airfoils** E D Martin (NASA, Ames Research Center, Moffett Field, Calif) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan. 16-18, 1978, Paper 78-11* 15 p 40 refs

A new version of the semidirect iterative method eliminates significant restrictions of previous versions of the method A semidirect method solves finite-difference equations by a rapid globally implicit iterative process driven by a fast direct elliptic solver The new approach can treat complex systems of equations in an efficient 'correction form', and allows the use of general, nonorthogonal, boundary-fitted coordinate transformations These features are expected to lead to significant practical applications with conservation-equation systems in either two or three dimensions The present application to the full potential equations for steady transonic flow over an airfoil at angle of attack illustrates the utility of the technique (Author)

A78-22554 * # **Measurements of unsteady vortex flow fields** F K Owen (Owen International, Inc , Palo Alto, Calif) and D A Johnson (NASA, Ames Research Center, Moffett Field, Calif) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-18* 10 p USAF-supported research, Contract No NAS2-9168

A combined surface hot film and laser velocimeter measurement technique, used to obtain new information on the mean, constant phase-averaged and turbulent structure of time-dependent flow fields, is described Data obtained in a cylinder wake are presented, and its structure in both the Eulerian and Lagrangian frames is discussed Turbulence data obtained by conventional and conditional averaging of the velocity fluctuations are also presented These data provide details of the small- and large-scale contributions to the total turbulent field (Author)

A78 22555 * # **Wake vortex measurements of bodies at high angle of attack** F K Owen (Owen International Inc , Palo Alto, Calif) and D A Johnson (NASA, Ames Research Center, Moffett Field, Calif) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-23* 10 p 7 refs USAF-supported research, Contract No NAS2-9168

Three-dimensional laser velocimeter measurements have been made of the wake vortices of a slender tangent-ogive body which had nose and body fineness ratios of 3 5 and 12, respectively Data were obtained for an angle of attack to seminose angle ratio of 2 3 at a free-stream Mach number of 0 6 and unit Reynolds number of 2 million/ft Details of the mean flow field are presented and features of the turbulent and unsteady nature of the vortex flow field are discussed Problems associated with obtaining meaningful vortex measurements in high-speed flows are addressed (Author)

A78-22556 * # **Analysis of heat transfer in a simulated wing-elevon cove in hypersonic flow** E G Keshock (Tennesse, University, Knoxville, Tenn) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-40* 9 p 11 refs Grant No NsG-1318

A simplified analytical model of leakage into a wing-elevon cove under high speed external flow conditions is presented The model accounts for convection from the high temperature gas stream leaking into the cove, radiation exchanges between walls and with the environment, and axial conduction within the channel walls Comparisons are made of predicted and measured wall temperatures of an experimental wing elevon-cove model that was tested in a hypersonic wind tunnel Analytically determined Nusselt numbers for laminar flow entrance conditions are compared with those calculated from experimentally measured gas temperatures, wall temperatures and wall heating rates Although reasonable agreement appears to be indicated, testing times much larger than those of the present test program (5 seconds) would be desirable in evaluating the reliability and accuracy of the simplified model (Author)

A78-22558 # **Research needs for U S Army aircraft propulsion** C L Walker (U S Army, Propulsion Laboratory, Cleveland, Ohio) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-45* 8 p 18 refs

Army aviation propulsion research, directed primarily toward the development of fuel-economizing gas turbine helicopter engines, is discussed High pressure ratio single-stage centrifugal compressors are under investigation, centrifugal compressor impeller design, thermal barrier coatings for turbine blades, and radial turbine lamination processes figure in the development program In addition, high-speed shafting, spiral-groove seals, small-bore high-speed ball and roller bearings, and squeeze film dampers for bearing supports are under study in the research program Characteristics of a 800-horse-power Advanced Technology Demonstrator Engine are presented J M B

A78-22561 # **A study of the inviscid flow about conically cambered delta wings** F Marconi and M J Siclari (Grumman Aerospace Corp , Bethpage, N Y) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-58* 12 p 13 refs Contract No F33615-77-C-3126

Finite difference methods were used to solve the Euler equations for the three-dimensional supersonic inviscid flow about

elliptic cones and spanwise conically cambered wings with subsonic leading edges Explicit shock fitting techniques were used to compute both the bow shock and embedded cross flow shocks New computational procedures were adopted in order to resolve the large flow field gradients developed in the vicinity of the leading edge of thin wings The effect of spanwise cambering was investigated and was found to reduce the leading edge suction peaks, but this reduction was accompanied by a corresponding loss in lift The computed nonlinear results were compared to linearized theory (Author)

A78-22570 * # **Stress analysis study in cooled radial inflow turbine** A Hamed, Y Sheoran, and W Tabakoff (Cincinnati, University, Cincinnati, Ohio) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-94* 10 p 9 refs Contract No NAS2-7850

With increased turbine inlet temperatures, numerical methods of thermal and stress analysis are becoming more valuable in the design of air-cooled turbines This paper presents a study of the stresses associated with different cooling patterns in a radial inflow turbine rotor The finite element method is used in the stress calculations taking into consideration centrifugal, thermal and aerodynamic loading The effects of temperature distribution and the presence of internal cooling passages are discussed (Author)

A78-22571 # **Application of laminar flow control to large subsonic military transport airplanes** C E Jobe (USAF, Flight Dynamics Laboratory, Wright Patterson AFB, Ohio), R M Kulran, and J D Vachal (Boeing Commercial Airplane Co , Seattle, Wash) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-95* 15 p

A study of performance increase that could result from applying advanced aerodynamic concepts to large, long range military transport aircraft showed that laminar flow control (LFC) offered the largest potential A more in-depth design study then investigated the impact of LFC on the performance, weight, fuel consumption, and economics of a military transport designed to carry 350,000 lb 10,000 nmi The design study identifies the optimum wing planform and cruise speed, the relative performance increases from different amounts of LFC, and sensitivities to the major LFC uncertainty items, i e , increased systems weight, complexity, and maintenance, which can only be quantified by design, development, and flight test (Author)

A78-22572 # **Aerodynamic optimization and analysis as part of the computer-aided design process** P E Divan, III (Rockwell International Corp , Los Angeles, Calif) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-97* 6 p

The general philosophy and methodology behind a computer-aided conceptual aircraft design process are discussed The building blocks of the computer system are examined, with emphasis on aerodynamic optimization and design Drag reduction at design conditions is performed in an interactive process including internal component arrangements and preliminary structural design, producing a highly cohesive air vehicle evolution When interactive computer graphics and analysis techniques are used throughout the process, from initial design to analysis output, a consistent data base is developed which provides an added integrity and realism to evolving configurations Finally, the improved efficiency of the design system over previous fragmented methods is demonstrated illustrating time and cost reductions Improved interface between disciplines which were previously decentralized is also achieved (Author)

A78-22573 # **Distributed load aircraft concepts** P C Whitener (Boeing Commercial Airplane Co , Seattle, Wash) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-100* 10 p

This paper presents distributed load aircraft design concepts that have as a major goal the significant increase in payload from reduction of the bending moments that are responsible for a large percentage of the structural weight The judicious use of advanced technology including composite structure and digital control of active control surfaces for gust alleviation, flutter suppression, and maneuver load control all contribute to reductions in bending moment to achieve significantly lower structural weight fractions The paper is based on a performance and economics study of a 2 8 million-pound gross weight distributed load freighter The results show significant potential improvements in energy conservation and operating economics when compared to today's aircraft (Author)

A78-22575 * # **Computational wing optimization and wind tunnel test of semi-span model** H P Haney, E G Waggoner (Vought Corp , Dallas, Tex), and W F Ballhaus (NASA, Ames Research Center, Computational Fluid Dynamics Branch, U S Army, Air Mobility Research and Development Laboratory, Moffett Field, Calif) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-102* 7 p 13 refs

A computational transonic wing design procedure has been developed and verified by a wind tunnel test of a variable camber semi-span wing model The Bailey-Ballhaus transonic potential flow analysis code linked to Vanderplaat's constrained minimization routine was used to optimize test configurations at 0 9 Mach number Based on wind tunnel test results, computationally optimized designs were as efficient as the best configurations determined by previous parametric testing and performed better at off-design points Wind tunnel wing pressures agreed well with predictions from the improved Bailey-Ballhaus code at moderate CL's Computational optimization was shown to be an effective transonic wing design tool (Author)

A78-22576 * # **Computational transonic flow about realistic aircraft configurations** C W Boppe (Grumman Aerospace Corp , Bethpage, N Y) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-104* 11 p 14 refs Contract No NAS1-14732

A numerical method has been developed to compute transonic flows about realistic wing-fuselage configurations The finite difference scheme employs an improved small disturbance flow equation A unique grid embedding technique, which was heretofore applied to airfoils and wings, has been extended to include the treatment of both body and wing-body shapes The resulting high-density mesh is shown to be a valuable asset in resolving details of the three dimensional flow A mathematical modeling system is used to process arbitrary fuselage geometries for body boundary conditions Correlations with experimental data for simple isolated bodies, an isolated fuselage, and wing-fuselage combinations are included (Author)

A78-22577 # **Transonic computational design modifications of the F-111 TACT** A W Chen (Boeing Commercial Airplane Co , Seattle, Wash), E N Tinoco, and H Yoshihara (Boeing Aerospace Co , Seattle, Wash) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-106* 8 p 10 refs

F-111 TACT tests at M = 0 9 and an angle of attack of 6 deg showed severe wing unloading in the inboard region over the glove and fuselage and a shock wave unsweeping in the tip region deteriorating the cruise performance A computational model is developed for use on the Bailey-Ballhaus transonic small disturbance code which allows a good simulation of the complex fuselage geometry, including inlet effects, of the F-111 TACT Comparisons with experiments show good agreement 'Fixes' are demonstrated which alleviate some of the aerodynamic deficiencies of the original aircraft (Author)

A78-22578 * # **Measured wake-vortex characteristics of aircraft in ground effect.** D L Ciffone (NASA, Ames Research Center, Moffett Field, Calif) and B Pedley *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-109* 10 p 13 refs

In support of the NASA wake vortex alleviation program, measurements were made of the influences of a ground plane on vortex trajectories and velocity profiles within lift generated wakes The wakes were generated by towing 0 61-m (2-ft) span models of two jumbo jets under water in a ship model basin The models were configured with landing flaps and flight spoilers to investigate the wake characteristics of these aircraft in ground effect at simulated full-scale distances of 19 m (62 ft) to 116 m (380 ft) above the ground The ground plane caused modifications in the vortex trajectories but did not alter vortex interactions and merging patterns in these multiple vortex wakes Some distortions in vortex vertical (tangential) velocity profiles were recorded as a result of vortex lateral motions and vortex interactions with the viscous boundary layer on the ground plane, however, maximum tangential velocities remained unchanged (Author)

A78-22579 * # **The role of atmospheric shear, turbulence and a ground plane on the dissipation of aircraft vortex wakes** A J Bilanin, M E Teske, and J E Hirsh *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan. 16-18, 1978, Paper 78-110* 11 p 14 refs Contract No NAS1-14707

Enhanced dispersion of two-dimensional trailed vortex pairs within simplified neutral atmospheric backgrounds is studied numerically for three conditions when the pair is imbedded in a constant turbulent bath (constant dissipation), when the pair is subjected to a mean cross-wind shear, and when the pair is near the ground Turbulent transport is modeled using second-order closure turbulent transport theory The turbulent background fields are constructed using a superequilibrium approximation The computed results allow several general conclusions to be drawn with regard to the reduction in circulation of the vortex pair and the rolling moment induced on a following aircraft (1) the rate of decay of a vortex pair increases with increasing background dissipation rate, (2) cross-wind shear disperses the vortex whose vorticity is opposite to the background, and (3) the proximity of a ground plane reduces the hazard of the pair by scrubbing The phenomenon of vortex bounce is explained in terms of secondary vorticity produced at the ground plane Qualitative comparisons are made with available experimental data, and inferences of these results upon the persistence of aircraft trailing vortices are discussed (Author)

A78-22584 # **Numerical simulation of the interaction of jet and freestream flows in engine exhaust systems** C K Forester (Boeing Aerospace Co , Seattle, Wash) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-144* 9 p 41 refs

A computer program with emphasis on computational efficiency and accuracy is being developed to analyze the plane or axisymmetric two-dimensional flow fields of an engine exhaust nozzle When developed, the program will yield the drag, loads, and internal losses on candidate engine nozzle installations The enormous variations in characteristic length scales featured by these flow situations are treated by matching different computational strategies together into a harmonious package The compressible inviscid portion of the flow field is computed with a shock-capturing code Gross separation is treated by a very efficient turbulent Navier-Stokes equation solver A compressible boundary layer code is used for the unseparated wall viscous flows Shear layers, slip surfaces, gross separation domains and the wall boundary layers have fitted mesh structure for computational efficiency The entire matched solution is achieved through an empirically tuned interactive scheme Progress on this code is reported in this paper (Author)

A78-22586 # **Real flow limitations in supersonic airplane design** R M Kulfan and A Sigalla (Boeing Commercial Airplane Co , Seattle, Wash) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-147* 31 p 30 refs

Experimental studies, including pressure measurements, force measurements and flow visualization techniques, have shown that predicted aerodynamic performance levels of supersonic wings can be achieved only when the flow remains attached over the entire wing surface The nature of the breakdown of potential flow on supersonic wings is discussed and illustrated with experimental flow visualization pictures and wind-tunnel data Various types of flow breakdown are examined Simplified flow analogies that explain these flow phenomena are developed Practical procedures that ensure design for attached flow at prescribed conditions are described Flow analogies are used to explore the impact of various airplane design parameters on the breakdown of attached flow (Author)

A78-22587 # **Configuration development of a supersonic cruise strike-fighter** R C Meyer (Grumman Aerospace Corp , Bethpage, N Y) and W D Fields (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-148* 9 p

Plans for a supersonic aircraft with both advanced cruise and air combat capabilities are discussed with attention to air-frame design The aircraft is intended to be operational in the 1985+ time period and will use either side inlets or pods in its engine configuration, with the engines based on today's technology The capabilities forseen, e g , air combat maneuverability of 3 5-4 0 G at Mach 0 9 at 10,000 meters, cruise speed of Mach 2, and SRAM payload of 5000 pounds, call for high lift/drag and thrust/weight ratios To achieve these goals, aircraft configuration features include twin nacelle arrangement, two dimensional wedge nozzles, variable geometry inlet, fully submerged tandem stores, variable attitude cockpit-canopy, control confiqured canard arrangement, variable twist/variable camber wing D M W

A78-22588 # **Arrow wings for supersonic cruise aircraft** B R Wright, F Bruckman, and N A Radovcich (Lockheed-California Co , Burbank, Calif) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-151* 12 p 5 refs

The arrow wing planform has a far greater range potential than the delta wing planform for utilization on a commercial supersonic cruise vehicle An SCV concept must be configured to favor cruise efficiency The arrow wing planform cruise lift-drag ratio is approximately one unit higher than the delta wing The small weight advantage of the delta wing cannot offset the large cruise efficiency advantage of the arrow wing The low speed aerodynamic characteristics of the arrow wing are acceptable and can be further improved by continued research and development For this, additional analytical tools need to be developed and wind tunnel tests conducted to provide verifications and empirical adjustments to the analytical tools The major emphasis to arrow wing development should be in the low speed regime The design challenge is to seek out design features and refinements that improve any deficiencies of the arrow wing while not sacrificing the superior cruise efficiency (Author)

A78-22589 * # **An interaction solution algorithm for viscous aerodynamic performance prediction** A J Baker (Tennessee, University, Knoxville, Tenn) and P D Manhardt (Computational Mechanics Consultants, Inc , Knoxville, Tenn) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-153* 13 p 28 refs Contracts No NAS1-14307, No NAS1-14855

A weak-interaction solution algorithm is established for aerodynamic flow field prediction about an isolated airfoil It requires

numerical solution of differential equations governing potential flow, viscous and turbulent boundary layer flow, and the turbulent wake flow downstream of a trailing edge The algorithm accounts for computed viscous displacement effects on the potential flow These in turn alter the viscous flow through imposed pressure gradients Closure for turbulence is accomplished using a second order model Numerical evaluations assess factors affecting solution accuracy, convergence and stability for the combined potential, boundary layer, and parabolic Navier-Stokes equation systems as solved using a finite element algorithm (Author)

A78-22590 * # **Two-dimensional separated wake modeling and its use to predict maximum section lift coefficient** M L Henderson (Boeing Commercial Airplane Co , Seattle, Wash) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 16th, Huntsville, Ala , Jan 16-18, 1978, Paper 78-156* 8 p 6 refs Contract No NAS1-14742

A technique for computing the lift of separating multielement airfoils in incompressible flow is presented The procedure employs repeated application of a panel method to solve for the separated wake displacement surface using entirely inviscid boundary conditions Results are presented that compare computed pressure distributions with those measured in the wind tunnel for airfoils with one, two, and four elements with separation on each element A method employing this technique is presented which shows promise in predicting airfoil section lift through stall (Author)

A78-22627 # **A superelement technique for designing helicopter fuselages (Superelementnyi metod rascheta fiuzeliazha vertoleta)** O M Aksenov and Z I Burman *Aviatsionnaia Tekhnika,* vol 20, no 2, 1977, p 12-17 7 refs In Russian

In the finite element technique proposed, the helicopter fuselage is broken down into bays in the frame planes These superelements are then joined to a precison equal to that of a 'nonpartioning' *scheme Using the method of forces, a theory and a general matrix* algorithm for calculating a helicopter fuselage are developed Cutouts are taken into consideration by the principle of superposed initial strains, either before or after joining For illustration, the method is applied to the calculation of an actual fuselage V P

A78-22630 # **Analysis of the determination of acceptance-inspection parameters for gas-turbine engines (Analiz formirovaniia parametrov dopuskovogo kontrolia GTD)** M Kh Bikchantaev and Iu V Kozhevnikov *Aviatsionnaia Tekhnika,* vol 20, no 2, 1977, p 31-35 In Russian

Formulas are derived for calculating the tolerances of gas-turbine-engine parameters The determination of tolerances as a function of measurement errors and of permissible values of the engine parameters is analyzed on the basis of extensive computational data, assuming that the permissible values are symmetrical with respect to the mathematical expectation V P

A78-22634 # **Modeling the influence of the ground effect on the aerodynamic characteristics of a wing by means of a flat screen of finite dimensions (K voprosu o modelirovanii vliianiia blizosti poverkhnosti zemli na aerodinamicheskie kharakteristiki kryla s pomoshch'iu ploskogo ekrana konechnykh razmerov)** S D Ermolenko and Iu A Rogozin *Aviatsionnaia Tekhnika,* vol 20, no 2, 1977, p 50-54 In Russian

A78-22636 # **Analysis and calculation of plane skew symmetric contours of second-order smoothness (Analiz i raschet ploskikh znakoperemennykh obvodov vtorogo poriadka gladkosti)** V P Zelev and V A Osipov *Aviatsionnaia Tekhnika,* vol 20, no 2, 1977, p 62-66 In Russian

The calculation of complex three-dimensional lines of flow of second-order smoothness forms the basis for designing channel surfaces In the present paper, it is proposed to use cubic parabolas, which in the general case possess five independent parameters, for designing skew symmetric contours of second-order smoothness A method of designing such contours with the aid of cubic parabolas is outlined, and its applicability for any combination of local characteristics is demonstrated V P

A78-22639 # **Distribution of reliability characteristics among aircraft units to ensure a given flight-safety level (O raspredelenii kharakteristik nadezhnosti mezhdu agregatami samoletnykh sistem dlia obespecheniia zadannogo urovnia bezopasnosti poletov)** G N Kotel'nikov *Aviatsionnaia Tekhnika,* vol 20, no 2, 1977, p 80-84 In Russian

A78-22640 # **Determination of the longitudinal lines of an aircraft fuselage by the special-contour method (Zadanie prodol'nykh linii fiuzeliazha samoleta metodom spetsial'nogo kontura)** S I Leliushenko and F K Chistiakov *Aviatsionnaia Tekhnika,* vol 20, no 2, 1977, p 85-88 In Russian

In order to optimize a complex program of designing 'fuselage-nacelle' type surfaces, it is proposed to calculate all transverse and longitudinal lines of an aircraft fuselage by the special-contour method A block diagram for computing longitudinal lines is given as a complement to the block diagram for designing a complex surface that satisfies a priori optimality criteria V P

A78-22642 # **Uniformly precise conformal mapping of the exterior of a circle onto the exterior of a wing section (Ravnomerno tochnoe konformnoe preobrazovanie vneshnosti kruga na vneshnost' krylovogo profilia)** N M Monakhov *Aviatsionnaia Tekhnika,* vol 20, no 2, 1977, p 94-98 In Russian

In the present paper, the local irregular part of the conformal mapping function is determined with a precision to quantities of second-order smallness, for the conformal mapping of the exterior of the sharp trailing edge of a wing section Using an irregular conformal mapping function it proved possible to map the entire region with a precision to quantities of fifth-order smallness The zero-lift angle which affects all the aerodynamic characteristics of the wing section is determined with a precision to quantities of fourth-order smallness V P

A78-22645 # **Dynamic model of a system of scientific research and industrial plants (Dinamicheskaia model' sistemy nauchno-issledovatel'skikh i proizvodstvennykh ob'ektov)** T K Sirazetdinov *Aviatsionnaia Tekhnika,* vol 20, no 2, 1977, p 112-117 In Russian

In this paper, an organization devoted to target science, that is, scientific research into means of perfecting specific aspects of production, is called a target scientific research plant The study concerns the derivation of equations for the development of a target scientific-research plant, where the output of such a plant is measured by the values of the economic indices of the production plant which it is investigating and serving P T H

A78-22646 # **An evaluation of weight optimization of aircraft radioelectronic equipment (Ob otsenke vesovogo sovershenstva samoletnoi radioelektronnoi apparatury)** V G Gogolin and I A Iskhakov *Aviatsionnaia Tekhnika,* vol 20, no 2, 1977, p 118, 119 In Russian

A78-22647 # **A study of the influence of slits on the effectiveness of wing mechanization and controls in separated flow (Issledovanie vliianiia shchelei na effektivnost' mekhanizatsii kryla i organov upravleniia pri sryvnom obtekanii)** V V Guliaev, A A Mikhailov, and M I Nisht *Aviatsionnaia Tekhnika,* vol 20, no 2, 1977, p 119-121 In Russian

A78-22649 # **Fatigue crack growth in a pressure-fuselage panel (O roste ustalostnykh treshchin v paneli germofiuzeliazha)** A B Kaplun and V D Kuliev *Aviatsionnaia Tekhnika,* vol 20, no 2, 1977, p 124-127 In Russian

In the present paper, the growth of fatigue cracks in an airliner panel under the combined effect of acoustic-pressure stresses and stresses associated with the difference in external and internal

pressure is analyzed within the framework of fracture mechanics The spectrum of alternating stresses generated by acoustic pressure is described by a Rayleigh distribution A method of evaluating the influence of acoustic-pressure stresses on the growth of fatigue cracks in a fuselage panel is proposed It is shown that under certain conditions, the influence of acoustic loads on crack growth exceeds by far that of the pressure difference V P

A78-22652 # **The experimental determination of the parameters of a mathematical model of an aircraft passenger compartment as a control plant with respect to air temperature (Eksperimental'noe opredelenie parametrov matematicheskoi modeli salona samoleta kak reguliruemogo ob'ekta po temperature vozdukha v nem)** V I Krutov, V G Voronin, and A V Shcherbakov *Aviatsionnaia Tekhnika,* vol 20, no 2, 1977, p 133-136 In Russian

A78-22724 **Fracture analysis of aerospace metals** H J Oberson, Jr (Boeing Commercial Airplane Co , Renton, Wash) *SAMPE Journal,* vol 13, Nov -Dec 1977, p 4-11

The intent of this paper is to outline, first, the value of fracture analysis, and then, the analytical methods employed in establishing the specific mechanism(s) responsible for crack initiation and subsequent growth Next, the cracking modes associated with the most widely used structural metals on commercial aircraft will be discussed Finally, two examples, one for an aluminum component and the other a low-alloy steel component, have been selected for detailed discussion based on the extensive analysis required and the interesting characteristics of the initial phase of crack propagation (Author)

A78-22737 # **Airworthiness criteria for aluminum alloy covering with uniform corrosion damage (Kriterii tekhnicheskogo sostoianiia obshivok iz aliuminievykh splavov s ravnomernymi korrozionnymi porazheniiami)** A I Radchenko and A E Sultanov (Kievskii Institut Inzhenerov Grazhdanskoi Aviatsii, Kiev, Ukrainian SSR) *Fiziko-Khimicheskaia Mekhanika Materialov,* vol 13, Sept - Oct 1977, p 98-101 In Russian

Fatigue tests were performed on 2 mm thick D16 ATV aluminum alloy aircraft sheath specimens subjected to a cyclic tension of 40-45 cycles/min at maximum stresses varying between 13 88 and 22 kg/sq mm Uniform corrosion damage was produced by 3% NaCl solution The fatigue life of corrosion-attacked specimens was compared to that of specimens with stress raisers in the form of 1-mm diam holes The life of corroded specimens fluctuated between 2900 and 260,000 cycles A least-squares statistical analysis of experimental data yielded airworthiness criteria in the form of correlational equations expressing service life in terms of corrosion depth in percents of initial plate thickness S D

A78-22848 # **The weight of fuel tanks in aircraft (Sul peso dei serbatoi del carburante nei velivoli)** G Gabrielli (Torino, Politecnico, Turin, Italy) *Ingegneria,* Nov -Dec 1977, p 321-324 In Italian

Semi-empirical relations are presented for determining the weight of aircraft fuel tanks as a function of structural factors, shape, the specific weight of the tank material, and the thickness of the tank envelope Both flexible envelope (nylon rubber) and metal (aluminum, magnesium or duraluminum) fuel tank designs are taken into account in the design program J M B

A78-22851 **The collision risk** J M Ramsden *Flight International,* vol 113, Jan 21, 1978, p 188-190

The rapidly expanding volume of air traffic expected between now and the end of the century necessitates a renewed emphasis on pilot responsibility for collision avoidance A system called 'Flightwatch' based on digital electronics is proposed as an on-board back-up to ground based air traffic control The system would function independently of the air traffic control loop, and would warn the pilot when a nearby aircraft is, or can be expected, at the same altitude Based on information from Flightwatch, a pilot could choose to override ground based instructions Technical problems involved in developing the system are seen as soluble within the framework of present technology D M W

A78-22852 # **Testing a modern strike aircraft navigation system** J B V Collins (Aeroplane and Armament Experimental Establishment, Boscombe Down, Wilts , England) *Journal of Navigation,* vol 31, Jan 1978, p 29-37, Discussion, p 37, 38

Consideration is given to the testing of a military aircraft navigation system in the United Kingdom The system is planned for a low-level strike role and for the continuous presentation of position and steering information The navigation system employs inertial navigation and a Doppler radar Testing consists of a sequence of steps (1) an indepth systems appraisal, (2) the development of simple system models, (3) the identification of factors which explain system behavior, (4) gathering statistics on operational factors, (5) the structuring of flight and ground trials, and (6) establishing mathematical models S C S

A78-22900 **Fire detection devices** L Graham *Aviation Engineering and Maintenance,* Nov Dec 1977, p 14, 17-20

Fire detection devices for aircraft cabins are evaluated on the basis of their reliability, ease of maintenance, and scope of function throughout the aircraft operating envelope Three atmospheric early warning signals are discussed, together with the most effective methods for their detection aerosols, best detected by ionization and photoelectric techniques, gases, best detected by using a gas-sensitive polymer film attached to a semi conductor, and heat energy, best detected by UV and IR sensors Laser beam, condensation nuclei, and resonant quartz crystal detectors are also considered A table is presented outlining operating parameters for the detection systems discussed D M W

A78-22937 **Special areas of gas dynamics Sonic, hypersonic, lifting surfaces, wave propagation (Spezialgebiete der Gasdynamik Schallnahe, Hyperschall, Tragflachen, Wellenausbreitung)** K Oswatitsch (Wien, Technische Universitat, Vienna, Austria) Vienna, Springer-Verlag, 1977 384 p 157 refs In German $90 80

Significant differences in gas dynamics result from varying aircraft speeds To account for the differences, the study of gas dynamics has been subdivided into specialized areas Among the topics discussed are influence of Mach number on flow distribution, stationary flow, friction-free flow, spatial and time-dependent wave-propagation, and stationary flow around a wing of infinite length Equations illustrating both generalized and exact solutions for specific flow problems are presented D M W

A78-23049 **Atmospheric turbulence loads on aircraft** J Taylor *Aeronautical Journal,* vol 81, Dec 1977, p 528-553 21 refs

The problems encountered by aircraft operating under conditions of turbulence are discussed with respect to determination of gust structure, aircraft reaction to gusts of known structure, and the determination of operating statistics A two-dimensional spectral density analysis is presented in which the rms velocity, vertical, and lateral components of air turbulence are evaluated in terms of their effects on roll, pitch, and angular velocity of an aircraft Load parameters are considered in relation to isotropic, homogeneous turbulence, with attention given to a Rayleigh distribution of level crossings Finally, digital data from flight recordings is given, in which an empirical estimation is made of the boundaries of a turbulence encounter D M W

A78-23050 **An aerofoil with control surface in incompressible viscous flow** B C Basu (Indian Institute of Technology, Kharagpur, India) *Aeronautical Journal,* vol 81, Dec 1977, p 554, 555 8 refs

A two-dimensional airfoil with a conventional trailing edge control surface is considered in terms of boundary layer effects A mathematical model is presented to analyze the respective roles of pressure distribution, lift and moment coefficients, and flow parameters D M W

A78-23058 # **Why the flexible wing II (Dlaczego sprezyste skrzydlo II)** J Wolf *Technika Lotnicza i Astronautyczna,* vol 31, Nov 1977, p 13-18 10 refs In Polish

The paper discusses the stability and dynamic characteristics of the flexible wing Models are presented for a pure wing Data demonstrating the superior performance of the flexible wing over the first- and second-generation Rogallo type wings and the wing used in the Eagle II glider are presented P T H

A78-23059 # **Application of light-emitting diodes /LEDs/ in aircraft analog indicators (Zastosowanie diod elektroluminescencyjnych /LED/ w lotniczych wskaznikach analogowych)** J Tomaszewicz (Instytut Lotnictwa, Warsaw, Poland) *Technika Lotnicza i Astronautyczna,* vol 31, Nov 1977, p 28-31 In Polish

The paper discusses the general features of control circuits for LED indicators An example of the development of an analog indicator using 13 luminous elements is given The system features a zero in the middle of the scale, a sensitivity of better than 1 mV per scale interval, and a four-bit A/D converter P T H

A78-23133 # **Observational computation in the case of redundant measurements (Observatsionnoe schislenie pri izbytochnykh izmereniiakh)** G Ia Dolgintseva, A A Ignatov, and N V Makarova (Leningradskii Institut Aviatsionnogo Priborostroeniia, Leningrad, USSR) *Priborostroenie,* vol 20, no 8, 1977, p 65-69 6 refs In Russian

Observational computation refers here to the continuous mode of determination of coordinates from data of position sensors in a radio navigation system The system considered consists of several position sensors and an autonomous system of computation, with constraints on memory capacity and the speed of the special digital computer As an example, a Kalman filter approach is used for the simultaneous processing of Loran and Shoran data B J

A78-23185 # **Analysis of unsteady viscous flow past an airfoil II - Numerical formulation and results** Z M Cielak and R B Kinney (Arizona, University, Tucson, Ariz) *AIAA Journal,* vol 16, Feb 1978, p 105-110 5 refs Research supported by the Alexander von Humboldt-Stiftung, NSF Grant No ENG-73-03855-A01

A numerical formulation of the analysis presented in Part I is developed The integral equation for the bound-vorticity distribution is cast into a system of linear simultaneous equations The unsteady vorticity transport equation is solved in finite-difference form using a standard technique which is explicit in time A semianalytical procedure is developed for the calculation of the velocity field via the Biot-Savart law The utility of the numerical method is demonstrated through calculations performed for the flow past a symmetrical Joukowski airfoil impulsively set into motion The airfoil thickness is approximately 12%, and results are presented for angles of attack of 0 deg and 30 deg for a Reynolds number of 400 Representative vorticity contours, velocity profiles, and pressure distributions over the airfoil surface are given An important feature of the method is that the pressure distribution is inherently single-valued, this being calculated directly from an integral of the bound-vorticity distribution over the surface The precision of the results is found to be quite good, even near the cusped trailing edge (Author)

A78-23188 # **Calculation of general three-dimensional turbulent boundary layers** A K Rastogi and W Rodi (Karlsruhe, Universitat, Karlsruhe, West Germany) *AIAA Journal,* vol 16, Feb 1978, p 151-159 28 refs

A finite-difference calculation method is described for three-dimensional boundary layers in which the flow depends on all three space variables The method employs the k-epsilon turbulence model and is applied to the following three flow situations boundary layer on a flat plate approaching a circular cylinder mounted on the plate, boundary layer beneath the leading-edge vortex on a delta wing, and boundary layer on the upper surface of a curved duct with both zero and adverse longitudinal pressure gradients The calculated skin friction, momentum thickness, shape factor, wall crossflow angle, and a few velocity and shear stress profiles are compared with available measurements The results demonstrate that the calculation procedure is general and economic and that the k-epsilon turbulence model involving the assumption of an isotropic eddy viscosity provides reasonable predictions for the quantities of engineering interest (Author)

A78-23219 **Two point correlations of jet noise** H S Ribner (Toronto, University, Downsview, Ontario, Canada) *Journal of Sound and Vibration,* vol 56, Jan 8, 1978, p 1 19 23 refs Grant No AF-AFOSR-75-2808B

A78-23247 **An experimental study of sound diffraction at an airfoil trailing edge** S N Heavens (Cambridge University, Cambridge, England) *Journal of Fluid Mechanics,* vol 84, Jan 30, 1978, p 331-335 12 refs Research supported by the Ministry of Defence and Science Research Council

Spark photography with a sensitive schlieren system has been used to show the interaction between an incident acoustic wave and the flow around an airfoil trailing edge Impact of the wave did not show any significant observable effect on the wake or trailing-edge boundary layer The intensity of the wave diffracted from the edge varied considerably with the prevailing flow conditions In the event of unsteadiness in the flow or boundary-layer separation the diffracted wave was strongly visible In smooth flows with attached boundary layers the diffracted wave was very weak These observations tend to support the recent conclusion of Howe (1976) that trailing-edge flows are quieter if they do not show singular behavior This is in contrast to the predictions of earlier theoretical models of the edge diffraction problem (Author)

A78-23274 **Method of calculating the compressible flow round an aerofoil or a cascade up to the shockfree transonic range.** T-S Luu and G Coulmy (CNRS, Laboratoire d'Informatique pour la Mecanique et les Sciences de l'Ingenieur, Orsay, Essonne, France). *Computers and Fluids,* vol 5, Dec 1977, p 261-275 19 refs

A numerical scheme based on discrete-distribution singularities is used to analyze compressible flow past a single airfoil or cascade When the freestream Mach number is beyond the upper limit of the shock-free regime, the computation becomes divergent Thus for each airfoil or cascade, this method indicates the upper limit of the freestream Mach number under which the shock-free flow may be realized Although the method involves a discrete treatment of space, it differs fundamentally from finite difference or finit element methods B J

A78-23295 **Some special boundary layer problems /20th Ludwig Prandtl Memorial Lecture/** A D Young (Queen Mary College, London, England) *Zeitschrift fur Flugwissenschaften und Weltraumforschung,* vol 1, Nov-Dec 1977, p 401-414 30 refs.

Laminar separation of bubbles is analyzed in relation to stall characteristics of aircraft wings The parameters of a reverse-flow vortex between the transition and reattachment components of a flow beneath the turbulent part of the shear layer are discussed Attention is given to comparisons between two-dimensional, or unswept, short bubbles and swept bubbles Also analyzed are flow characteristics in corners and junctions, especially the wing-fuselage junction Laminar and transition flows are described in terms of their effect on total airframe structure D M W

A78-23297 **The low-speed air tunnel of the Institute of Hydromechanics at the University of Karlsruhe (Der Niedergeschwindigkeitswindkanal des Instituts fur Hydromechanik an der Universität Karlsruhe)** R Ermshaus and E Naudascher (Karlsruhe, Universitat, Karlsruhe, West Germany) *Zeitschrift fur Flugwissenschaften und Weltraumforschung,* vol 1, Nov-Dec 1977, p 419-425 7 refs In German Research supported by the Stiftung Volkswagenwerk

A variety of research projects in the fields of Environmental Fluid Mechanics and Building Aerodynamics require for their solution an air-tunnel facility combining an accurately adjustable uniform flow (including flow of low turbulent intensity) with a very long working section The following report describes the design and

construction of the low-velocity wind tunnel of the Institute of Hydromechanics at the University of Karlsruhe whose octogonally-shaped closed test-section has a length of 8 m and a diameter of 1 5 m The turbulence intensity of the axial velocity fluctuations in the test section over the whole range of mean velocity (0 to 45 m/sec) does not exceed 0 1% The feasibility to position the remotely-controlled probe carriage is a great help in the conduct of experiments. Initial tests for the determination of flow characteristics are reported (Author)

A78-23372 # **Spectrum crack growth in adhesively bonded structure** W S Johnson, W C Rister, and T Spamer (General Dynamics Corp , Fort Worth, Tex) *(American Society of Mechanical Engineers, Winter Annual Meeting, Atlanta, Ga , Nov 27-Dec 2, 1977, Paper 77-WA/Mat-7) ASME, Transactions, Journal of Engineering Materials and Technology,* vol 100, Jan 1978, p 57 63 21 refs.

A method is presented by which crack growth of damage tolerance type flaws can be predicted in adhesively bonded structure subjected to spectrum loading The method accounts for a laminate stress intensity correction factor, induced bending and axial load transfer between plies, as well as a crack growth analysis procedure to predict the crack growth retardation behavior under spectrum load Analytical predictions are compared to several test results to show the applicability of the prediction method presented (Author)

A78-23373 # **Development of random fatigue data for adhesively bonded and weldbonded structures subjected to dynamic excitation** K R Wentz and H F Wolfe (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) *(American Society of Mechanical Engineers, Winter Annual Meeting, Atlanta, Ga , Nov 27-Dec 2, 1977, Paper 77 WA/Mat-1) ASME, Transactions, Journal of Engineering Materials and Technology,* vol 100, Jan 1978, p 70-76 9 refs

Prediction methods are being developed to determine the sonic fatigue life of various weldbonded and adhesively bonded aircraft structures when exposed to high intensity acoustic excitation This paper describes the results of the experimental investigations performed by the AF Flight Dynamics Laboratory to obtain the factors that affect the random fatigue life of typical aircraft structural joint configurations The structures tested included full-scale components, simple beam sections, and acoustic panel configurations A variety of aluminum skin thicknesses, stiffener configurations, and bond systems have been tested under dynamic excitation The bond systems tested begin with the weldbond systems developed in the early 1970s up to the present bond systems Random flexural fatigue curves for two modes of failure have been developed adhesive bond system failure and metal fatigue failure These curves are part of the design criteria needed to predict the sonic fatigue life of weldbonded and adhesively bonded structures (Author)

A78-23398 # **Prediction of the ascending speeds of gliders in thermal convection over a plain (Prévision des vitesses ascendantes des planeurs en convection thermique de plaine)** R Vaillant (Météorologie Nationale, Boulogne-Billancourt, Hauts-de-Seine, France) *La Météorologie,* Sept 1977, p 77-91 In French

The paper provides a meteorological analysis of the problem and presents a graph procedure for calculating the ascending speed of gliders that rise in thermal convection over a plain The main input parameter is the desired height of flight, which is equal to the altitude of the top of the thermal convection system or to the altitude of the base of a cumulus cloud (since gliding within a cloud is illegal) The nebulosity as expressed in an 8-point scale must also be determined The relationship between the desired height and the ascending speed is found to be linear, and the y-intercept is determined by the nebulosity (the relationship of which to the ascending speed is roughly bell-shaped) The relationship of the ascending speed to the maximum ascending speed is linear, this latter quantity, produced by vertical gusts, is of interest to gliders who will often wait for the gusts A table of corrections sometimes required when clouds other than cumulus are present is provided M L

A78-23412 **Power conditioning systems for high-power, airborne, pulsed applications** A S Gilmour, Jr (New York, State University, Buffalo, N Y) *(Pulsed Power Systems Workshop, Silver Spring, Md , Sept 1976) IEEE Transactions on Aerospace and Electronic Systems,* vol AES-13, Nov 1977, p 660-678 23 refs USAF-supported research

Power conditioning systems and critical component developments are defined which will be required to interface airborne 10-50 MW sources Power conditioning systems for use with MHD generators and turbine driven alternators, both conventional and superconducting, are considered Component analyses include estimations of necessary development efforts and of specific weights and volumes for components The primary components considered are transformers, (for alternator as well as inverter use), switches, capacitors, and inductors Weight algorithms are developed for each of these components Subsystems such as inverters, and rectifier and filter packages are also examined B J

A78-23420 # **Where aerospace can serve afresh - Paths to energy independence** W M Hawkins (Lockheed California Co , Burbank, Calif) *Astronautics and Aeronautics,* vol 16, Feb 1978, p 32-36

The national goal of independence from foreign energy sources, i e , Mid east oil, is considered with respect to the relationship between industry and government, and the feasibility of developing new energy technologies Attention is given to the role the aerospace industry could play in contributing to U S energy self-sufficiency Assets of the aerospace industry include a proven diversity of engineering talent, experience with technological risk, and experience in dealing with a wide variety of government agencies Among the new technologies proposed are using fusion explosions to generate superheated steam, nuclear-based conversion of seawater to hydrogen, methane production from plants and waste, ocean thermal energy conversion and coal gasification D M W

A78-23421 * # **Toward scramjet aircraft** R A Jones and P W Huber (NASA, Langley Research Center, Hypersonic Propulsion Branch, Hampton, Va) *Astronautics and Aeronautics,* vol 16, Feb 1978, p 38-48 11 refs

The possibility for civil, military, and remotely piloted aviation above Mach 5 is discussed with reference to the scramjet Actively cooled aircraft structures of low weight are described, together with jet nozzle design and combustion parameters The scramjet is seen as operating alone or in tandem with ramjet propulsion, which would power an aircraft up to scramjet speeds Attention is given to the specific impulse of the scramjet engine, with hydrogen as the primary fuel Applications include advanced reconnaissance and interceptor aircraft, strategic cruise (both aircraft and missiles), highly-maneuverable interceptor missiles, transports, aircraft-type launch vehicles, first stages for Space Shuttle launching craft, and single-stage-to-orbit vehicles Research has focused on increasing the propulsion power of the scramjet engine, while reducing drag on the accompanying airframe D M W

A78-23433 * **Wear studies on aircraft brake materials** T L Ho (Rensselaer Polytechnic Institute, Troy, N Y) In Wear of materials - 1977, Proceedings of the International Conference, St Louis, Mo , April 25-28, 1977 New York, American Society of Mechanical Engineers, 1977, p 70-76 19 refs Grant No NGR-33-018-152

An investigation of both worn surfaces of friction pads and steel rotors which are being applied in current aircraft brakes has been carried out by employing an X-ray diffraction technique It consists of the analysis of chemical element distribution in the surface layers The wear particles were also examined by using the scanning electron microscope The initiation and growth of surface cracks and the oxidation were emphasized in this investigation A wear model was proposed for the current aircraft brake materials Essentially this model proposed that cracks are formed in the surface layer of the brake material due to the normal and frictional stresses It is primarily surface temperature dependent (Author)

A78-23439 **Mechanism of wear in helicopter hydraulic systems** O Johari, S V Samudra, I Corvin, and J Staschke (IIT Research Institute, Chicago, Ill) In Wear of materials - 1977, Proceedings of the International Conference, St Louis, Mo , April 25-28, 1977 New York, American Society of Mechanical Engineers, 1977, p 265-273 Grant No DAAJ01-73-C 0781

The operational safety of helicopter hydraulic systems is monitored presently by periodic checks of oil using spectrographic oil analysis Such analysis does not explain the mechanism of wear or which particular component is wearing SEM/X-ray spectroscopy of the wear particulates, however, shows a wealth of information on morphology and origin of the wear particles The nature of wear patterns of different components and their relation to the wear particles is explained here The major cause of the wear is shown to be the contamination of the system by sand particles entering through seals and the embedding of particles in the seals resulting in polishing type of wear Evidence is presented for the nature of these contaminant particles and sources of their entry into the system, and recommendations are made for minimizing such contamination through design modifications (Author)

A78-23441 **Coatings for fretting prevention** B K Gabel and J J Bethke (U S Naval Material Command, Naval Air Development Center, Warminster, Pa) In Wear of materials - 1977, Proceedings of the International Conference, St Louis, Mo , April 25-28, 1977 New York, American Society of Mechanical Engineers, 1977, p 331-336 6 refs

The purpose of the considered program was to determine the optimum fretting fatigue resistant coatings for titanium steel mating surfaces found in helicopter rotor hub assemblies Several problems have been encountered during component accelerated fatigue tests of the hub assembly, where fatigue failures of the titanium hub initiated at areas of severe fretting In order to address this problem, a program was developed to evaluate candidate coatings in terms of their ability to reduce or eliminate fretting of Ti 6Al-4V when in contact with 17-4 PH steel This paper will describe the new fretting test apparatus, the results obtained thus far on screening selected coatings which might have potential for fretting protection, and an evaluation of bend bar test specimen configuration designed to achieve fretting fatigue under conditions comparable to those experienced in the actual rotor hub assemblies (Author)

A78-23451 * # **Friction and wear of sintered fibermetal abradable seal materials** R C Bill (NASA, Lewis Research Center, U S Army, Air Mobility Research and Development Laboratory, Cleveland, Ohio) and L T Shiembob (United Technologies Corp , Pratt and Whitney Aircraft Group, East Hartford, Conn) *ASME, ASTM, ASM, SME, ASLE, and SAE, International Conference on Wear of Materials, St Louis, Mo , Apr 25-28, 1977, Paper* 26 p 10 refs

Three abradable gas-path seal-material systems based on a sintered NiCrAlY fiber metal structure were evaluated under a range of wear conditions representative of those likely to be encountered in various knife-edge seal (labyrinth or shrouded turbine) applications Conditions leading to undesirable wear of the rotating knife were identified, and a model proposed based on thermal effects arising under different rub conditions It was found, and predicted by the model, that low incursion (plunge) rates tended to promote smearing of the low-density sintered material with consequent wear to the knife edge Tradeoff benefits between baseline 19 percent dense material, a similar material of increased density, and a self-lubricating coating applied to the 19 percent dense material were identified on the basis of relative rub tolerance and erosion resistance (Author)

A78-23457 # **The location of the ground focus line produced by a supersonic aircraft** R Makarewicz (Poznan, Uniwersytet, Poznan, Poland) *Archives of Acoustics,* vol 2, no 3, 1977, p 167-176 7 refs

Algorithms are derived for determining where shock waves caused by a sonic boom will be focussed on the earth's surface The analysis considers the 'coupled cone' associated with the Mach cone and the superposition of at least two N waves in space and time The location of the ground focus line produced by an aircraft which is accelerating while traveling at supersonic speed is also determined for the case of travel in a linear flight path Although some focussing is considered inevitable because of the necessity of aircraft to vary speed for corrective maneuvers, it is thought that it will be possible to avoid disturbing populated areas with sonic booms caused by aircraft M L

A78-23470 # **Systems analysis of safety in aviation I (Systemowa analiza bezpieczenstwa w lotnictwie I)** J Morawski and T Smolicz *Technika Lotnicza i Astronautyczna,* vol 32, Dec 1977, p 20 22 In Polish

A logical basis for analyzing safety in aviation is proposed Four classes of likelihood of an event and three classes of seriousness of the consequences of the event are suggested Events are either malfunctions (e g , of aircraft equipment or ground control equipment), external random events (e g , atmospheric ones), and errors (due to improper action or failure of action on part of personnel) Classifications are discussed for quality of giving an instruction, understanding an instruction, performance skills, equipment and working conditions, time factor, and final result Some reasons for the greater percentage of pilot errors causing accidents in civil aviation than in commercial aviation are discussed P T H

A78-23471 # **Airports for short takeoff and landing (Lotniska krotkiego startu i ladowania)** B Rzeczynski *Technika Lotnicza i Astronautyczna,* vol 32, Dec 1977, p 23-26 6 refs In Polish

The future growth of passenger air traffic in Poland is predicted, and the desirability of introducing short takeoff and landing airports into the passenger air network is discussed These airports may serve minor provincial capitals or industrial and tourist centers, or they may be located in large cities and operate in conjunction with conventional airports P T H

A78-23574 **The strength of structures and the applications of the fracture mechanics** W Barrois *Engineering Fracture Mechanics,* vol 10, no 1, 1978, p 109-114 7 refs

Documentation on the application of fracture mechanics to the selection of aluminum alloys subject to fatigue cycling is briefly reviewed Attention is given to the role of fracture mechanics in determining the stress intensity factor and fatigue crack growth rate as related to the strength of structures It is expected that the maximum useful knowledge for the designer would be provided by detailed theoretical and experimental analyses of each case of local failure or damage occurring during static strength tests and full-scale fatigue tests as well as of damage occurring during operations in actual aircraft structures S D

A78-23575 **Stresses and displacements due to load transfer by fasteners in structural assemblies** W Barrois *Engineering Fracture Mechanics,* vol 10, no 1, 1978, p 115-176 23 refs

Theoretical aspects of stress concentration and subsequent displacement in critically loaded structural assemblies are examined for the cases of a loaded hole (double symmetrical shear) and rivet or bolt shanks stresses in single shear For the first case, the concept of reference lines on strips at cross sections, where stress distributions through the strip widths are fairly uniform, is applied, this allowed approximate computation of strip strains and relative displacements between assembled strips The second case is discussed relative to absolutely rigid fastener shanks, flexible pin or fastener shank, and side plates and reinforcements Since fatigue cracks originate from the material surface, at a notch root or at a hole edge, the relevant terms of comparison are the surface stress at the crack origin and its stress gradient S D

A78-23801 **YAH-64 advanced attack helicopter design tradeoffs** J C Dendy (Hughes Helicopters, Culver City, Calif) *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif , Nov 14-17, 1977, Paper 770950* 13 p

A description of the U S Army's advance attack helicopter, YA-64, is presented A comparison is made between various crew station configurations, and the final design selection is discussed The target acquisition/designation system, the primary sighting system, is described along with the design criteria of the landing gear The main features of the tail rotor drive system are identified and attention is given to specifications of the aircraft's performance margin and operational flexibility S C S

A78-23802 **The Bell Model 222** J R Garrison and H H Waldrup (Bell Helicopter Textron, Fort Worth, Tex) *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif , Nov 14-17, 1977, Paper 770951* 15 p

The design objectives, features and performance of the recently developed Bell Model 222 is described in terms of primary design objectives, including safety, efficiency, reduced cost of ownership, and superior handling qualities From the test results, the Model 222 is a fuel conservative, productive aircraft with excellent flying qualities The 222 far exceeds the FAA requirements for fail safe design and crashworthiness Redundancy, 8g seats, crash resistant fuel tanks, and real twin-engine safety are examples The latter refers to the fact that for any altitude at which the helicopter can hover OGE, it can continue to cruise if one engine fails The first flight was in August 1976 and development is essentially complete The aircraft will be delivered in early 1979 (Author)

A78-23803 **Army UTTAS program** R A Wolfe (U S Army, Aviation Research and Development Command, St Louis, Mo) *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif , Nov 14-17, 1977, Paper 770952* 11 p 7 refs

A brief history into the background of the Army's requirements and need for a UTTAS, history of development, general description with intended missions, planned activities and significant capabilities is presented It is shown that concentrated efforts on reliability and maintainability characteristics when combined with stringent performance and survivability requirements provide an aircraft with enhanced operational capabilities on the modern day battlefield (Author)

A78-23804 * **XV-15 tilt rotor test - Progress report.** J H Brown, Jr , H K Edenborough (U S Army, Aviation Research and Development Command, Moffett Field, Calif), and D D Few (NASA, Ames Research Center, V/STOL Aircraft Technology Div , Moffett Field, Calif) *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif , Nov. 14-17, 1977, Paper 770953* 10 p

In a continuing effort to expand the versatility of their aircraft, VTOL designers have for many years tried to combine the desirable features of various concepts into a single aircraft This is a formidable task and most efforts have met with limited success This paper explores the need for an aircraft combining the efficient VTOL capability of a helicopter with the efficient high speed characteristics of a fixed wing turboprop The ability of the tilt rotor concept to fill this requirement and examples as to its potential usefulness in both military and civil missions is discussed The history of the concept and the status of the current Army/NASA/Bell XV 15 program and its role in proving the viability of the concept are reviewed (Author)

A78-23805 **Status report on the Advancing Blade Concept /ABC/ technology demonstrator program** V P Bailey (United Technologies Corp , Sikorsky Aircraft Div , Stratford, Conn) *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif , Nov 14-17, 1977, Paper 770954* 14 p 8 refs

The Advancing Blade Concept (ABC), employing a coaxial, counter-rotating, extremely stiff rotor system, is described, the ABC is intended to circumvent high-speed limitations of rotorcraft resulting from retreating blade stall Rigidly attached to the rotor hub, the opposing advancing blades function as wings and permit high-speed cruise, good climb characteristics, and a high degree of maneuverability A flight demonstrator utilizing the ABC has attained a 156-knot velocity at 10,000 feet, and a maximum forward dive speed of 192 knots J M B

A78-23815 **747 Shuttle Carrier Aircraft/Space Shuttle Orbiter mated ground vibration test - Data via transient excitation and fast Fourier transform analysis** N L Olsen and M J Walter (Boeing Co , Seattle, Wash) *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif , Nov 14-17, 1977, Paper 770970* 10 p 6 refs

A78-23816 **Flutter tests of the mated 747 Shuttle Carrier Aircraft-Orbiter** L V Andrew (Rockwell International Corp , Space Div , Downey, Calif) *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif , Nov 14-17, 1977, Paper 770971* 14 p 6 refs

Flutter tests of the mated 747 Shuttle Carrier Aircraft-Orbiter are discussed from the viewpoint of the flutter engineer of the prime Space Shuttle contractor, the Space Division of Rockwell International The telemetered data that he and the other test team members monitored on real-time displays are described, as are the safety criteria applied during buffet tests The instrumentation and telemetering of orbiter data are treated for both the unpowered (inert) and the powered up (active) orbiter Highlights of each flight, including the crew's comments, are reported, along with details pertinent to the structural dynamics of the system (Author)

A78-23818 ***Transient expansion of the components of an air seal on a gas turbine disc*** N R L Maccallum (Glasgow, University, Glasgow, Scotland) *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif , Nov 14-17, 1977, Paper 770974* 11 p 11 refs

Using simple finite-difference models with appropriate boundary conditions, methods have been developed for predicting the movements of the critical components of an air seal on the face of the first High Pressure Turbine Disc of a typical two-spool Gas Turbine The methods have been applied to two testing transients - the acceleration and the deceleration between the Ground Idling and Maximum Speeds In the acceleration, seal openings of double the equilibrium value are predicted to persist for 30 s after completion of the speed transient (Author)

A78 23819 **Holographic inspection of jet engine composite fan blades** E J Delgrosso and C E Carlson (United Technologies Corp , Hamilton Standard Div , Windsor Locks, Conn) *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif , Nov 14-17, 1977, Paper 770975* 9 p

A holographic inspection method was developed for composite spar/shell fan blades, such as an experimental fan blade and an advanced fan blade This method was employed to insure the quality of newly fabricated blades Holographic inspection also was used to indicate initiation and growth of cracks as a result of resonant fatigue testing and spin testing Metallographic examinations were conducted to show the good correlation between the holographic data and actual blade structures (Author)

A78-23820 **Turbine engine slip ring technology - A survey** J A Young, T H Gogoll, and E W Glossbrenner (Litton Industries, Poly-Scientific Div , Blacksburg, Va) *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif , Nov 14-17, 1977, Paper 770976* 9 p

Aircraft turbine engine development is requiring more and more spool data to be recorded during testing This data, which normally consists of thermocouple and strain gage type signals, demands so many channels of quality transmission as to preclude bulky and costly telemetry devices Miniature slip ring capsule assemblies, originally developed for inertial navigation equipment, have been adapted and used in turbine applications at speeds in excess of 30,000 revolutions per minute These slip ring and brush contacts are characterized by low resistance variation or other electrical interference The principal adaptation required to achieve these life times is the provision of an adequate coolant/lubricant supply (Author)

A78-23821 **Impact of engine cycle parameters on V/STOL Type A configuration and commonality** J D Louthan (Vought

Corp , Dallas, Tex) *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif , Nov 14-17, 1977, Paper 770980* 19 p

Selection of thrust geometry, lift cruise fan parameters and the number of core engines is discussed for a Naval V/STOL aircraft capable of a wide variety of missions A tandem fan design, featuring a common propulsion system, common wings and tails, and a common basic fuselage structure for both conventional and VTOL flight, is described The tandem fan propulsion system uses four fans to generate VTOL thrust and permits compact nacelle and fan design An analysis is presented to illustrate the effects of various degrees of commonality on the cost-effectiveness of V/STOL aircraft J M B

A78-23822 Sensitivity studies for several high performance VSTOL concepts H H Driggers (Vought Corp , Dallas, Tex) *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif , Nov 14-17, 1977, Paper 770982* 10 p

Several VSTOL fighter/attack study configurations employing alternative propulsion concepts were evaluated to common mission, performance and technology groundrules This paper describes each concept and compares weight sensitivities for variations in mission and combat performance constraints The lowest takeoff weight and highest performance was achieved by the vertical attitude takeoff and landing (VATOL) configurations A similar lift plus lift/cruise design was typically 10 percent heavier for equal performance Ejector and fan augmentors were not competitive with jet lift concepts on a performance basis All configurations were capable of vertical landing with one engine inoperative (Author)

A78-23823 * Development of the propulsion simulator - A test tool applicable to V/STOL configurations M F Eigenmann (McDonnell Aircraft Co , St Louis, Mo) and R O Bailey (NASA, Ames Research Center, Moffett Field, Calif) *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif , Nov 14-17, 1977, Paper 770984* 13 p

A turbine engine multi-mission propulsion simulator, capable of representing inlet/airframe/nozzle flowfield interactions for supersonic V/STOL aircraft wind tunnel models, is described The propulsion simulator replaces conventional aero flow-through and jet effects models with a single model, flow field interactions modeled by the simulator may include close-coupled inlets and nozzles, non-axisymmetric vectoring exhaust nozzles, and forward canards mounted near the inlets and wings Wind tunnel tests of the simulation system at Mach numbers up to 1 2 are reported for a model typical of a F-15 aircraft installation The possibility of applying the simulator to advanced V/STOL design programs is also discussed J M B

A78-23824 The impact of emerging technologies on tactical V/STOL airplane design and utility I H Rettie and R C Sutton (Boeing Co , Seattle, Wash) *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif , Nov 14-17, 1977, Paper 770985* 11 p

A new look at tactical combat V/STOL design and utility as affected by emerging technology and mission concepts is given in this paper History has shown that a certain level of useful load fraction must be attained before an airplane system can be considered operationally successful Technology trends reviewed in this paper suggest that the time is here or at least near for V/STOL tactical aircraft to achieve a truly viable useful load fraction Propulsion, structure, and controls technologies will contribute to the success of the tactical V/STOL system In addition, aerodynamic technology as related to interference effects in hover and transition, and as required for efficient supersonic cruise and combat, significantly impacts the design solution A unique approach to system design risk assessment is described with results giving technology leverage as a function of design options (Author)

A78-23825 Development of low pressure ratio vectoring nozzles for V/STOL aircraft C R Limage (Vought Corp , Dallas, Tex) *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif , Nov 14-17, 1977, Paper 770988* 10 p

Results of a parametric test program of low pressure ratio deflected nozzles show the performance changes to be significant for vectoring nozzles and variations in nozzle thrust coefficients should be included in engine cycle trade studies to obtain realistic aircraft performance Low pressure ratio deflected nozzle performance is shown to be sensitive to nozzle pressure ratio, nozzle contraction ratio, turning radius, diffuser area ratio and the presence of an integral core flow exhaust stream The effectiveness of venting the inside surface of the nozzle turn is also demonstrated (Author)

A78-23826 A clutch for V/STOL W H Thomas (General Motors Corp , Detroit Diesel Allison Div , Detroit, Mich) *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif , Nov 14-17, 1977, Paper 770989* 9 p

This paper describes the requirements, design, and early testing of a flight weight V/STOL clutch A clutch is required between the combiner box and the forward or nose fan for some versions of V/STOL aircraft This clutch has been designed to transmit 11,000 HP at fan drive speeds, and be capable of minimum engagement times and rapid cycling This paper will cover the mechanical arrangement and control system of this clutch (Author)

A78-23827 Modular engine maintenance concept considerations for aircraft turbine engines D B Edmunds (USAF, Propulsion Performance/Stability Div , Wright-Patterson AFB, Ohio) *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif , Nov 14-17, 1977, Paper 770991* 7 p

Maintenance of modular gas turbine aircraft engines is discussed, with emphasis on experience gained from the U S Air Force F100 engine, which consists of fan, core, fan drive turbine, augmentor and main gear box modules The five modules are tracked as separate entities in maintenance programs, resulting in more efficient fault isolation and decreased repair times, though also an increase in record-keeping A gas path analysis program and measurements obtained from engine trim runs provide information about the performance of the individual engine modules Structural failure detection techniques as applied to modular engines are also mentioned J M B

A78-23828 Gas turbine module performance analysis A R Ebstein (United Technologies Corp , Pratt and Whitney Aircraft Group, East Hartford, Conn) *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif , Nov 14-17, 1977, Paper 770992* 15 p

A new approach to analyzing changes in gas turbine engine module performance levels has been developed This method utilizes two dimensional vector space digrams and nomographs which describe module performance changes as a function of dependent gas path parameter changes The slopes and magnitudes of the vectors are determined from influence coefficients for the engine cycle being analyzed (Author)

A78-23829 Gas path analysis applied to pre and post overhaul testing of JT9D turbofan engine S-G Danielsson (Scandinavian Airlines System, Stockholm, Sweden) *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif , Nov 14-17, 1977, Paper 770993* 23 p

A78-23830 Condition monitoring experience on CF6 engines H Kent and R Kroc *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif , Nov 14-17, 1977, Paper 770994* 23 p

Condition monitoring of the CF6 aircraft engine may involve trend plots of gas path and mechanical parameters, spectrographic oil analysis programs, borescope inspection and radiography. Three methods of obtaining trend plots are considered manual plotting base on flight logs and calculation sheets, semiautomatic plotting which involves computerized presentation of manually recorded data, and the Airborne Integrated Data System, which provides a complete flight record of parameters, including trends recorded during takeoff Examples of gas path parameter trend analysis and vibration data monitoring are mentioned J M B

A78-23831 **Concorde AIDS - Powerplant applications** P J Wheeler (British Airways, Hounslow, Middx, England) and N J Essex (Rolls-Royce, Ltd, London, England) *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif, Nov 14-17, 1977, Paper 770995* 18 p

The Airborne Integrated Data System (AIDS) has been adopted as an analytic tool for Concorde propulsion system maintenance programs, the AIDS data are used in performance trend monitoring, engine control law verification, and low cycle fatigue life assessments Trend plots of such parameters as rear and front vibrations, jet pipe pressure, turbine cooling air temperature and primary nozzle area are recorded for takeoff, subsonic climb, supersonic climb, and supersonic cruise (The thermodynamic parameter values are corrected to account for the various engine inlet conditions and running points) Objectives of the AIDS powerplant monitoring program include assessment of long-term component deterioration and avoidance of overseas engine changes J M B

A78-23833 **Twenty year evolution of the WR2/WR24 series of small turbojet engines** R J Mandle (Williams Research Corp, Walled Lake, Mich) *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif, Nov 14-17, 1977, Paper 770998* 19 p

Development of miniature turbojet engines, which have been applied to reconnaissance drone propulsion, is described At their origin in the late 1950s, the miniature turbojet engine created 50 lb of thrust, while present models are capable of more than 200 lb of thrust Particular attention is given to the integrated governor and alternator assembly incorporated in the small turbojets Recently, a miniature turbojet engine has been developed with the capability of a one hour flight, a maximum altitude of 20,000, and variable-speed flight The advanced design employs oil mist lubrication and is intended to be reusable up to 20 times following recovery in sea water J M B

A78-23834 **Design and analysis of propellers for low Reynolds number application to mini-RPV's.** H V Borst *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif, Nov 14-17, 1977, Paper 770999* 27 p 27 refs Grant No DAAJ02 C-0031

This report presents the design and analysis of propellers applied to mini-remotely piloted vehicles along with the methods used Modifications to the airfoil data used for predicting the profile drag losses were necessary to account for operation at the low Reynolds number encountered by mini-RPV propellers The correction was determined from the available airfoil data and low Reynolds number propeller test data Using the revised methods of propeller analysis, optimum propellers were designed and analyzed The study showed that improved performance can be obtained with new propeller designs (Author)

A78-23835 **Constant speed generating systems** J V Burns (Sunstrand Aviation Corp, Rockford, Ill) *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif, Nov 14-17, 1977, Paper 771001* 17 p

Synchronous generators operating at constant speed are used to supply the electric power systems of most modern aircraft The constant speed salient pole generator inherently develops the output power in the desired form, a sine wave of 400 hertz frequency The hydromechanical constant speed drive, a straightforward, rugged combination of a planetary gear set and hydraulic units, is most frequently chosen to achieve the constant speed The design of the constant speed generating system has evolved through experience, development, and state-of-the-art advances The current system, the integrated drive generator, has the advantages of weight, performance, reliability, and ease of maintenance Continued engineering effort is dedicated to achieving further advances (Author)

A78-23836 **Variable speed constant frequency /VSCF/ aircraft electrical power** E B Canfield and J. W Summerford (General Electric Co, Aircraft Equipment Div, Utica, N Y) *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif, Nov. 14-17, 1977, Paper 771002* 10 p

A description is presented of the operation, design, performance, and application of high reliability, variable speed constant frequency (VSCF) aircraft electric power generating systems A high frequency, multiphase, brushless generator supplies power to a frequency converter which conditions the variable frequency generator output into precision 3-phase, 115/200V, 400 Hz aircraft power, using the cycloconverter principle Systems have been built with ratings from 20 to 150 kva For a 75 kva system, the weight to rating ratio is about 1 6 lbs/kva and rated load efficiency is 80% Predicted MTBF for current systems is in the 2000 to 6000 hour range (Author)

A78-23837 **Electronic converter electric power supply /ECEPS/ - KC-135** R Kautz (Bendix Corp, Electric and Fluid Power Div, Eatontown, N J) *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif, Nov 14-17, 1977, Paper 771003* 6 p

The ECEPS Package for the KC-135 aircraft is a direct replacement for the 40 KVA CSD Generator Package that now exists in that aircraft It is a 60 KVA system and fits in the same area It consists of a gearbox, a generator, a dc link converter, and an air-to-oil heat exchanger The entire system is oil cooled (Author)

A78-23838 **Electromechanical flight control actuation** D K Bird (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif, Nov 14-17, 1977, Paper 771004* 10 p

Electromechanical actuation design, recently revolutionized by the introduction of rare-earth samarium-cobalt magnets, now offers the possibility of efficient electromechanical actuation for flight control Weight, space and power requirements of electromechanical actuators are compared with those of hydraulic actuators An electromechanical actuator to drive a trailing edge control surface is described, fail-safe measures designed to insure that the surface does not become a flutter exciter are also considered In addition, the difficulty of reconciling maximum instantaneous horsepower requirements and the need for low weight actuators is mentioned J M B

A78-23839 **Flight testing an 8000 psi Lightweight Hydraulic System** J N Demarchi (Rockwell International Corp, El Segundo, Calif) and J Ohlson (U S Naval Material Command, Naval Air Development Center, Warminster, Pa) *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif, Nov 14-17, 1977, Paper 771007* 15 p 9 refs

This paper describes the flight testing of an 8000 psi Lightweight Hydraulic System The objective was to reduce weight and space requirements of the hydraulic system in future, high density Navy aircraft An 8000 psi Lateral Control System was installed in a T-2C (basic Navy trainer) airplane Four different pilots evaluated the test installation, accumulating a total of 11 5 flight hours No malfunctions occurred in the 8000 psi system, pilot comments were favorable Operational characteristics of the 8000 psi system were very similar to the T-2C 3000 psi lateral control system The test installation performed exceptionally well, fluid temperatures were nominal, pressure fluctuations were small, fluid particulate generation was low, and component endurance was projected to be satisfactory (Author)

A78-23840 * **Preliminary QCSEE program - Test results** C C Ciepluch (NASA, Lewis Research Center, Cleveland, Ohio) *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif, Nov 14-17, 1977, Paper 771008* 11 p

Preliminary results are reported for the Quiet Clean Short haul Experimental Engine (QCSEE) program initiated by NASA in 1974 to develop propulsion system technology suitable for powered-lift short-range commercial aircraft The QCSEE technology also has applications to the proposed U S Navy V/STOL aircraft Emphasis in the QCSEE program is placed on developing engines with low noise characteristics, in addition, the power plants are required to conform to EPA 1979 pollutant emissions standards Thrust perfor-

mance, fan design, and thrust/weight ratio are discussed for both the over-the-wing and under-the-wing engine configurations under study
J M B

A78-23841 Advanced turboprop propulsion system reliability and maintenance cost P C Stolp (General Motors Corp, Detroit Diesel Allison Div, Detroit, Mich) and J A Baum (United Technologies Corp, Hamilton Standard Div, Windsor Locks, Conn) *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif, Nov 14-17, 1977, Paper 771009* 18 p 13 refs

The reliability and maintenance cost (R&MC) for an advanced turbine engine and prop-fan propulsion system is projected for high speed commercial airline use in the 1990s The R&MC values are compared with current turboprop values and detailed discussion of the advances necessary to achieve the projected R&MC is provided to substantiate maintenance cost reductions on the order of 50 to 60% These advances include an on-condition maintenance philosophy in conjunction with diagnostics to monitor system performance, improved reliability in the initial design that is consistent with airline usage and life requirements, improved modularity to reduce line maintenance time and aircraft down time, and simplified hardware in conjunction with modularity to reduce shop maintenance cost Comparison of the advanced turboprop system maintenance cost with that of an advanced turbofan system shows it has competitive levels
(Author)

A78-23842 Advanced supersonic transport propulsion systems R A Howlett and M G Smith, Jr (United Technologies Corp, Pratt and Whitney Aircraft Group, East Hartford, Conn) *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif, Nov 14-17, 1977, Paper 771010* 18 p

A Supersonic Cruise Airplane Research program (SCAR) has been initiated by NASA to evaluate the performance of various engines for commercial supersonic flight The main requirement for the engines is that they combine high thrust capability with low noise The most important parameter in this regard is the bypass ratio All other aircraft parameters must be designed around bypass ratio performance Different Variable Cycle Engines (VCE) are evaluated, including front, rear, and dual valve VCE's, low-bypass engines, turbofan, and ramjet engines The most promising concept is the Variable Stream Control Engine (VSCE) because it meets the performance requirements mentioned above, and can operate efficiently over a wide range of temperatures, at both sonic and supersonic speeds
D M W

A78-23843 * Ramjet propulsion for single-stage-to-orbit vehicles J A Martin (NASA, Langley Research Center, Hampton, Va) *Society of Automotive Engineers, Aerospace Meeting, Los Angeles, Calif, Nov 14-17, 1977, Paper 771011* 7 p

The concept of single stage earth-to-orbit transportation is studied with respect to existing and projected ramjet technology Four types of ramjet are analyzed fan ejector, fan ramjet, supersonic combustion ramjet, and fan ramjet with turbojet boosters A fan ramjet with a removable fan, with separate rockets for the non-air-breathing flight phase, is considered superior to an ejector ramjet, for both ease of orbit insertion and payload boost capability Vehicle design is also discussed in terms of trajectory integration and optimization, aerodynamic trim and stability, and complete mass estimation Graphs are presented showing Mach number for air-breathing and non-air-breathing flight, specific impulse from various ramjet engines, and orbital-insertion parameters
D M W

A78-23862 Sensor failure detection using analytical redundancy T B Cunningham (Honeywell, Inc, Minneapolis, Minn) and R D Poyneer (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) In Joint Automatic Control Conference, San Francisco, Calif, June 22-24, 1977, Proceedings Volume 1 New York, Institute of Electrical and Electronics Engineers, Inc, 1977, p 278-287 29 refs Contract No F33615-76-C-3031

Analytical redundancy is investigated to replace costly redundant sensors currently needed to maintain reliable flight control Two concepts are developed, one based on frequency domain techniques and the other using Kalman filtering These are designed to interface with comparison monitors of a dual sensor-dual computer system on board the A-7D multi-mode research aircraft The structure creates a fail-operative condition after one failure and fail safe after two for redundant pairs of like sensors and fail safe for single sensor failures A third concept is also developed which provides fault detection and isolation through analytical redundancy Two monitor algorithms are described, a constant or scheduled trip level criteria and a sequential likelihood ratio test (SLRT) Design techniques for obtaining low rms error signals and consistant responses with parameter variations are also described Finally, hybrid simulation is used to evaluate the performance of these designs A combination of Concept I and II algorithms and the SLRT monitor is recommended for further evaluation through flight test
(Author)

A78-23873 * Integrity in flight control systems P R Kurzhals and R Deloach (NASA, Washington, D C) In Joint Automatic Control Conference, San Francisco, Calif, June 22-24, 1977, Proceedings Volume 1 New York, Institute of Electrical and Electronics Engineers, Inc, 1977, p 489-497 17 refs

In connection with advances in technology, mainly in the electronic area, aircraft flight control applications have evolved from simple pilot-relief autopilots to flight-critical and redundant fly-by-wire and active control systems For flight-critical implementations which required accommodation of inflight failures, additional levels of redundancy were incorporated to provide fail-safe and fail-operative performance The current status of flight control systems reliability is examined and high-reliability approaches are discussed Attention is given to the design of ring laser gyros and magnetohydrodynamic rate sensors, redundancy configurations for component failure protection, improvements of hydraulic actuators made on the component level, integrated actuators, problems of software reliability, lightning considerations, and failure detection methods for component and system failures
G R

A78-23879 Filtered sequential regression parameter identification applied to a gas turbine engine model D E Warner and E D Ward (Purdue University, West Lafayette, Ind) In Joint Automatic Control Conference, San Francisco, Calif, June 22-24, 1977, Proceedings Volume 2 New York, Institute of Electrical and Electronics Engineers, Inc, 1977, p 697-703 14 refs

In this paper a filtered sequential regression parameter identification technique is developed which is feasible for on-board digital computer implementation on gas turbine engines When applied to a test second order system, this filtered sequential technique is superior to a nonfiltered sequential technique for noisy data The practicality of the technique is demonstrated by application to data generated from a twin-spool gas turbine engine model A simplified linear set point model was identified using the two spool speeds as state variables The model obtained with this filtered sequential regression technique matched the system state response to within 2 percent accuracy
(Author)

A78-23883 * New frequency domain methods for system identification N K Gupta (Systems Control, Inc, Palo Alto, Calif) In Joint Automatic Control Conference, San Francisco, Calif, June 22-24, 1977, Proceedings Volume 2 New York, Institute of Electrical and Electronics Engineers, Inc, 1977, p 804-808 10 refs Contracts No N00014-76-C-0420, No NAS2-8799

This paper presents two new techniques for frequency domain identification of linear system parameters The first technique uses the instrumental variables approach The frequency domain formulation is shown to give a considerable insight into the selection of efficient and convergent instrumental variables The new maximum likelihood formulation affords simpler numerical solution and provides a way to select parameter starting values in the gradient based optimization method
(Author)

A78-23889 **System identification principles applied to multivariable control synthesis of the F100 turbofan engine** R L De Hoff and W E Hall, Jr (Systems Control, Inc , Palo Alto, Calif) In Joint Automatic Control Conference, San Francisco, Calif , June 22 24, 1977, Proceedings Volume 2 New York, Institute of Electrical and Electronics Engineers, Inc , 1977, p 1007-1012 8 refs Contract No F33615-75-C-2053

An evaluation of engine control technology has demonstrated that engine functions for future aircraft engine requirements should be implemented with digital, multivariable designs relying on hydromechanical hardware for back-up and fail-operate functions One potential tool for achieving these objectives is based on quadratic synthesis methods A description is presented of two types of algorithms which produce linear models for control synthesis on turbine engines The offset derivative procedure requires a detailed nonlinear digital simulation Models generated represent simulation variables and dynamics, and a reduction procedure is required to produce low order design systems These procedures are computationally efficient but may be sensitive to system nonlinearities and perturbation step size System identification procedures are computationally more demanding The resulting models tend to represent the behavior of the engine over a wider range of input magnitudes and trim conditions G R

A78-23890 * **Frequency domain compensation of a DYNGEN turbofan engine model** R M Schafer, R R Gejji, P W Hoppner, W E Longenbaker, and M K Sain (Notre Dame, University, Notre Dame, Ind) In Joint Automatic Control Conference, San Francisco, Calif , June 22-24, 1977, Proceedings Volume 2 New York, Institute of Electrical and Electronics Engineers, Inc , 1977, p 1013-1018 8 refs NSF Grant No ENG-75-22322, Grant No NsG-3048

Following Rosenbrock's ideas regarding the advantages of dominance in linear multivariable control systems, a new graphical technique is used for the design of compensators that achieve dominance The technique is illustrated with an application to the problem of designing compensators for a linear turbofan-engine model The resulting design is put into perspective by examining it in the light of two other multivariable frequency-domain methods One, MacFarlane's method of characteristic loci, is used to realize a final design for stability and low interaction The other is a direct technique based upon the algebraic expansion of the determinant of the return difference in terms of it's elements Results from simulations carried out on the NASA DYNGEN software are included (Author)

A78-23891 * **The application of the Routh approximation method to turbofan engine models** W C Merrill (NASA, Lewis Research Center, Cleveland, Ohio) In Joint Automatic Control Conference, San Francisco, Calif , June 22-24, 1977, Proceedings Volume 2 New York, Institute of Electrical and Electronics Engineers, Inc , 1977, p 1019-1028 9 refs

The Routh approximation technique is applied in the frequency domain to a 16th order state variable turbofan engine model The results obtained motivate the extension of the frequency domain formulation of the Routh method to the time domain to handle the state variable formulation directly The time domain formulation is derived and a new characterization, which specifies all possible Routh similarity transformations, is given This characterization is computed by the solution of two eigenvalue-eigenvector problems The application of the time domain Routh technique to the state variable engine model is described and some results are given Additional computational problems are discussed including an optimization procedure which can improve the approximation accuracy by taking advantage of the transformation characterization (Author)

A78-23892 * **Minimum-time acceleration of aircraft turbofan engines** F Teren (NASA, Lewis Research Center, Cleveland, Ohio) In Joint Automatic Control Conference, San Francisco, Calif , June 22-24, 1977, Proceedings Volume 2 New York, Institute of Electrical and Electronics Engineers, Inc , 1977, p 1029-1037 12 refs

Minimum time accelerations of the F100 turbofan engine are presented A piecewise-linear engine model, having three state variables and four control variables, is used to obtain the minimum-time solutions The linear model which applies at a given time in the trajectory is determined by calculating a normalized 'distance' from the current state to the equilibrium state associated with each linear model The linear model associated with the closest equilibrium point is then used The control histories for the minimum-time solutions are used as input to a nonlinear simulation of the F100 engine to verify the accuracy of the piecewise-linear solutions (Author)

A78-23893 * **Optimal controls for an advanced turbofan engine** G L Slater (Cincinnati, University, Cincinnati, Ohio) In Joint Automatic Control Conference, San Francisco, Calif , June 22 24, 1977, Proceedings Volume 2 New York, Institute of Electrical and Electronics Engineers, Inc , 1977, p 1038-1043 10 refs Contract No NAS3-18021

Linear optimal control theory is applied to the control synthesis of a high bypass ratio, variable pitch, turbofan engine The basic control philosophy is to use only a low order dynamic model of the plant coupled with the concept of integral-output states so as to maintain control simplicity yet guarantee integral control of thrust, turbine temperature and other important engine outputs Linear simulation results indicate that the control system developed provides rapid control of small thrust perturbations and quickly eliminates the effect of unmodelled thrust and temperature disturbances Large thrust accelerations are obtained in about one half second while the control maintains negligible overshoot in temperature and stall margins (Author)

A78-23900 **A singular perturbation analysis of optimal aerodynamic and thrust magnitude control** A J Calise (Dynamics Research Corp , Wilmington, Mass) In Joint Automatic Control Conference, San Francisco, Calif , June 22-24, 1977, Proceedings Volume 2 New York, Institute of Electrical and Electronics Engineers, Inc , 1977, p 1248-1260 19 refs Contract No F49620-76-C-0037

This paper illustrates the application of singular perturbation methods to optimal thrust magnitude control (TMC) and optimal lift control in flight mechanics A multiple time scale analysis results in nonlinear feedback control solutions for lift and thrust during a turn to a specified down range position The analysis is carried out to first order with respect to the position state variables Numerical results for a medium range and a short range air-launched missile are given, and comparisons are made to two alternative propulsion control concepts The multiple time scaling procedure used here is applicable to solving a wide class of optimal control problems It avoids the problem in asymptotic methods of picking the unknown adjoints to suppress unstable modes in the boundary layer and reduces the two-point boundary value problem to a series of point-wise function extremizations Hence the optimal control solution is essentially analytic and algebraic (Author)

A78-23901 **Singular perturbation analysis of optimal flight profiles for transport aircraft** R Aggarwal, A J Calise, and F Goldstein (Dynamics Research Corp , Wilmington, Mass) In Joint Automatic Control Conference, San Francisco, Calif , June 22-24, 1977, Proceedings Volume 2 New York, Institute of Electrical and Electronics Engineers, Inc , 1977, p 1261-1269 10 refs Contract No F33615-76-C-3104

This paper carries out a multiple time scale analysis of optimal flight profiles for transport aircraft Nonlinear feedback solutions for the optimum altitude and throttle setting as a function of the aircraft energy state are derived The analysis takes into account the decrease in aircraft weight as fuel is consumed during the flight It is shown that a first order analysis corrects the optimal control solution for fuel consumption during climb Numerical results for a C-141 aircraft for short range and long range profiles are given These are compared to a gradient solution for the full state problem The paper concludes

with a discussion on the real time implementation aspects of the optimal control algorithm (Author)

A78-23906 **Failure state detection of aircraft engine output sensors** W R Wells (Wright State University, Dayton, Ohio) and C W de Silva (MIT, Cambridge, Mass) In Joint Automatic Control Conference, San Francisco, Calif , June 22-24, 1977, Proceedings Volume 2 New York, Institute of Electrical and Electronics Engineers, Inc , 1977, p 1493-1497 9 refs

In this work a technique to detect the failure state of aircraft engine output sensors is developed The technique automatically makes optimal estimates of the outputs corresponding to failed states These estimates can in turn be used to control the engine until the normal operation of engine sensors is restored The technique is then applied to a realistic turbojet engine model (Author)

A78-23907 * **Design of turbofan engine controls using output feedback regulator theory** W C Merrill (NASA, Lewis Research Center, Cleveland, Ohio) In Joint Automatic Control Conference, San Francisco, Calif , June 22-24, 1977, Proceedings Volume 2 New York, Institute of Electrical and Electronics Engineers, Inc , 1977, p 1504-1509 9 refs

A multivariable control design procedure based on output feedback regulator (OFR) theory is applied to the F100 turbofan engine Results for the OFR design are compared to a design based on linear quadratic regulator (LQR) theory This LQR design was obtained as part of the F100 Multivariable Control Synthesis (MVCS) program In the MVCS program the LQR feedback control was designed in a reduced dimension state space and then applied to the original system However, the OFR feedback control is designed in the full order state space and thus eliminates any need for model reduction techniques Using the performance measure and control structure of the MVCS program LQR design, an equivalent OFR feedback control is obtained The flexibility of the OFR as a control design procedure is demonstrated and differing feedback control structures are evaluated (Author)

A78-23909 * **Solution of transient optimization problems by using an algorithm based on nonlinear programming** F Teren (NASA, Lewis Research Center, Cleveland, Ohio) In Joint Automatic Control Conference, San Francisco, Calif , June 22-24, 1977, Proceedings Volume 2 New York, Institute of Electrical and Electronics Engineers, Inc , 1977, p 1549-1560 11 refs

A new algorithm is presented for solution of dynamic optimization problems which are nonlinear in the state variables and linear in the control variables It is shown that the optimal control is bang-bang A nominal bang-bang solution is found which satisfies the system equations and constraints, and influence functions are generated which check the optimality of the solution Nonlinear optimization (gradient search) techniques are used to find the optimal solution The algorithm is used to find a minimum time acceleration for a turbofan engine (Author)

A78-23917 * **Robustness of linear quadratic state feedback designs in the presence of system uncertainty** R V Patel, M Toda, and B Sridhar (NASA, Ames Research Center, Moffett Field, Calif) In Joint Automatic Control Conference, San Francisco, Calif , June 22-24, 1977, Proceedings Volume 2 New York, Institute of Electrical and Electronics Engineers, Inc , 1977, p 1668-1673 15 refs

The paper deals with the problem of expressing the robustness (stability) property of a linear quadratic state feedback (LQSF) design quantitatively in terms of bounds on the perturbations (modeling errors or parameter variations) in the system matrices so that the closed-loop system remains stable Nonlinear time-varying and linear time-invariant perturbations are considered The only computation required in obtaining a measure of the robustness of an LQSF design is to determine the eigenvalues of two symmetric matrices determined when solving the algebraic Riccati equation corresponding to the LQSF design problem Results are applied to a complex dynamic system consisting of the flare control of a STOL aircraft The design of the flare control is formulated as an LQSF tracking problem S D

A78-23918 * # **Failure detection and correction for turbofan engines** R C Corley (General Electric Co , Group Engineering Div , Cincinnati, Ohio) and H A Spang, III (GE Research and Development Center, Schenectady, N Y) *AIChE, ASME, IEEE, ISA, and SME, Joint Automatic Control Conference, San Francisco, Calif , June 22-24, 1977, Paper* 7 p Contract No NAS3-18021

In this paper, a failure detection and correction strategy for turbofan engines is discussed This strategy allows continuing control of the engines in the event of a sensor failure An extended Kalman filter is used to provide the best estimate of the state of the engine based on currently available sensor outputs Should a sensor failure occur the control is based on the best estimate rather than the sensor output The extended Kalman filter consists of essentially two parts, a nonlinear model of the engine and up-date logic which causes the model to track the actual engine Details on the model and up-date logic are presented To allow implementation, approximations are made to the feedback gain matrix which result in a single feedback matrix which is suitable for use over the entire flight envelope The effect of these approximations on stability and response is discussed Results from a detailed nonlinear simulation indicate that good control can be maintained even under multiple failures (Author)

A78-24007 # **Approaches to improving aircraft efficiency** C J Slivinsky (Rockwell International Corp , General Aviation Div , Bethany, Okla) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 14th, Washington, D C , Feb 7-9, 1978, Paper 78-305* 4 p

Investigations have been conducted concerning the approaches which can be used to increase the cost effectiveness of general aviation type aircraft It was found that the utilization of larger propellers turning more slowly develops the highest thrust per horsepower ratio The employment of such propellers in connection with aerodynamic and material improvements being developed will permit aircraft to go faster and carry more payload while flying at higher altitudes for longer periods of time Turboprop engines have demonstrated both a lighter weight per horsepower and a higher degree of reliability than higher powered piston engines Configurations which use two turboprop engines driving a single propeller and tied together by a combined gear box offer twin engine reliability and could obtain aircraft efficiency well beyond those presently available G R

A78-24008 # **Engine development toward lower energy consumption and reduced environmental impact** E L Smith and H R Bishop (Pratt and Whitney Aircraft of Canada, Ltd , Longueuil, Quebec, Canada) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 14th, Washington, D C , Feb 7-9, 1978, Paper 78-307* 12 p 7 refs

The paper discusses the current state of development of small gas turbine engines for General Aviation Areas examined include powerplant types, developments in component efficiency and probable future improvements Over the next 10 year period, small gas turbine engines are expected to evolve further towards still lower fuel consumption, continued high reliability, low operating cost and minimum environmental impact in terms of noise and emissions Fixed wing powerplants are addressed in the paper but the engine improvements considered will be equally applicable to helicopter powerplants (Author)

A78-24009 # **Flight on 0 33 horsepower - The Gossamer Condor** P B MacCready (AeroVironment, Inc , Pasadena, Calif) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 14th, Washington, D C , Feb 7-9, 1978, Paper 78-308* 7 p

Flight testing experience and performance calculations are discussed for a human-powered aircraft which won the Kremer Prize in 1977 The aircraft is based on computer aided propeller and airfoil designs, the structure consists of Mylar over aluminum tubing with

piano wire for support The 96-foot span vehicle, having a gross weight of 207 lbs, performed the 7 1/2 minute flight (including a figure-eight maneuver) at an average power of 0 42 horsepower
J M B

A78-24010 # **Conversion of an automotive engine for aircraft application** L J Yuhas (Rutgers University, New Brunswick, N J , General Electric Co , Aircraft Engine Div , Cincinnati, Ohio) and G E Sumka (Rutgers University, New Brunswick, N J , General Electric Co , Technical Marketing Div , Bridgeport, Conn) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 14th, Washington, D C , Feb 7-9, 1978, Paper 78-309* 8 p 10 refs

Experimental aircraft require lightweight, dependable, and low cost power plants Automotive internal combustion engines may be used for this application In this investigation, an air cooled Corvair automotive engine was selected for possible conversion To develop a high torque at low crankshaft speeds without gear reduction, several modifications were considered These changes included exhaust system modifications to reduce exhaust manifold back pressures, carburetor modification which allows for controlled air-fuel mixtures, and modification of the ignition system to dual-magneto ignition which increased performance and dependability The paper describes these modifications and their effects on the converted power plant's performance (Author)

A78-24011 # **A solution to the direct problem of an open propeller using the streamline curvature method** M J Pierzga (Pennsylvania State University, State College, Pa) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 14th, Washington, D C , Feb 7-9, 1978, Paper 78-310* 9 p 9 refs

A method is presented of analyzing the flow field and predicting the performance characteristics of an open propeller The flow field is calculated using the streamline curvature method, an iterative procedure which simultaneously satisfies the principles of conserva tion of total energy, momentum and continuity The direct problem solution requires the calculation of the outlet flow angles for the propeller blade sections These flow angles are a combination of the measured blade outlet angles and the deviation angles due to real fluid effects The method of calculating these deviation angles is described in detail Once the flow field has been established, the propeller performance parameters can then be calculated using simple momentum and energy considerations Good correlation between predicted data and experimental measurements has been obtained using this direct analysis method (Author)

A78-24012 # **Digital simulation of aircraft flight path dynamics using quaternions** R J Goodman (Virginia Polytechnic Institute and State University, Blacksburg, Va) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 14th, Washington, D C , Feb 7 9, 1978, Paper 78-311* 12 p 7 refs

A summary is presented on the development of a computer program which provides a flexible inexpensive easy-to-use tool for solving general vehicle performance problems The equations used in describing the instantaneous dynamic motions of a vehicle in flight are reviewed However, the description obtained from these equations is incomplete due to mathematical singularities at vehicle flight-path angles of + or - 90 deg This incompleteness is eliminated by introducing the concept of the quaternion as an unambiguous means of representing body orientations The incorporation of quaternions into the equations of motion is discussed in detail Brief comments are also made on the structuring of the program to give a better understanding of its adaptability to solve a wide range of performance problems and yet still be simple and inexpensive to use The validity of the program's solutions for different performance problems is then illustrated by comparing the results from modeling several flight paths directly with solutions obtained using other performance analysis techniques (Author)

A78-24013 # **An analysis of the aircraft trailing vortex system** J J Tartaglione (Notre Dame, University, Notre Dame, Ind) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 14th, Washington, D C , Feb 7-9, 1978, Paper 78-312* 9 p 12 refs

A review of the aircraft trailing vortex system is presented Particularly the transport and decay of the vortex system and its potential hazard to other aircraft is discussed In addition an analysis of trailing vortex decay data is presented Although various theories have been proposed for predicting the decay of a vortex system, most of them have failed when compared with flight test data Recently Iversen proposed a method for correlating trailing vortex data based upon a variable eddy viscosity vortex decay model His model was applied to previously uncorrelated flight test data The data used, which was obtained by the National Aviation Facilities Experimental Center (NAFEC), includes measurements of the vortex structure behind nearly all the large commercial jet transports The correlation technique was found to successfully collapse the trailing vortex data to a single curve Thus, Iversen's assumption of variable eddy viscosity is the key factor that enables a universal collapse of both the model and flight test data (Author)

A78-24016 # **VSTOL - Can Navy needs be met** D F Mow (U S Navy, Office of the Chief of Naval Operations, Washington, D C) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 14th, Washington, D C , Feb 7-9, 1978, Paper 78-322* 6 p

The U S Navy has made the decision to transition its Sea Based Air forces to VSTOL This decision is subject only to a validation that the VSTOL concept of operations will satisfy the Navy's needs A broad matrix of studies are ongoing to investigate thoroughly the role that VSTOL aircraft can play in the Navy of the future VSTOL permits greater flexibility in aircraft carrier design and extends the advantages of Sea Based Air across a broader spectrum of ships Greater tactical flexibility and strategic mobility are available to the task force commander and higher authority in operating naval forces in support of national policy (Author)

A78-24017 # **'New look' in assurance technology - 'The Hornet'** D Malvern and J P Capellupo (McDonnell Aircraft Co , St Louis, Mo) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 14th, Washington, D C , Feb 7-9, 1978, Paper 78-323* 6 p

Assurance technology, i e , the reliability and maintainability of aircraft, has taken on an increasingly important role in light of concern with military spending The F/A-18 Hornet is presented as an aircraft with state-of-the-art assurance technology, including built-in-test and on-aircraft maintenance, providing rapid fault-isolation, short repair time, and low failure rates Deployment of the F/A-18 during the 1980's is expected to substantially reduce aircraft down-time, and allow for efficient operation over a wide range of environments D M W

A78-24018 # **Airborne electronic warfare in the modern military force** A R Salzmann (Grumman Aerospace Corp , Bethpage, N Y) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 14th, Washington, D C , Feb 7-9, 1978, Paper 78-324* 10 p

The development of electronic warfare is traced from its beginnings in World War 2 to the present day Attention is given to the Navy EA 6B and the Air Force EF-111A, designed for the F-111 aircraft These jamming systems are seen as operating in three basic modes barrier stand-off, in which a few F 111's operate in a holding pattern behind friendly lines and foil enemy reconnaissance of our own forces, close air support, where F 111's venture just over enemy lines and jam enemy radar so that tactical aircraft can strike at their targets, and penetration escort, in which electronic warfare is conducted well behind enemy lines Modern electronic warfare systems are fully integrated into the operation of an aircraft, digitally controlled, and computerized to handle routine chores, so that the human operator can deal with the unusual and the unexpected
D M W

A78-24022 # **A least square finite element technique for transonic flow with shock** A R Wadia (Cornell University, Ithaca, N Y) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 14th, Washington, D C , Feb 7-9, 1978, Paper 78-328* 13 p 18 refs Grant No AF-AFOSR-74-2659

The governing differential equation for the one-dimensional, transonic flow in a laval nozzle in the vicinity of the throat was obtained in the non-dimensional form A least square finite element technique was used with a linearly interpolating polynomial to reduce the governing equation to a system of non-linear algebraic equations which were solved numerically by Newton's method The system of partial differential equations for the two dimensional flow in a laval nozzle was also obtained in the non-dimensional form The method of integral relations was used to replace the original system of partial differential equations by a system of ordinary differential equations Using the least square finite element technique a computer program was developed for the construction and solution of the non-linear equations for the laval nozzle problem The results including the location of the shock in the flow are presented (Author)

A78-24025 # **An investigation into the effects of shear on the flow past bluff bodies** C Fiscina *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 14th, Washington, D C , Feb 7-9, 1978, Paper 78-331* 10 p 11 refs NSF Grant No GK-42991

A curved screen was used to produce a low-turbulence shear flow in a wind tunnel test section The turbulence intensity was less than 0 5%, and a 20% linear shear profile was produced Experiments were performed on four rectangular cylinders 60, 45, 30, and 15 cm in height with 2 1 and 1 2 aspect ratios Measurements were made to determine the frequency of vortex shedding in the wake of the model with shear and without shear Frequency measurements of the vortex shedding showed a number of cells across the span of the cylinder, each with a different frequency The flows were influenced strongly at the top of model due to the finite height The cells boundaries fluctuated with time At certain times the frequency spectra showed a broadening with dual peak frequencies corresponding to the unsteadiness in cell structure (Author)

A78 24031 # **Technology readiness for an SST** R D FitzSimmons (Douglas Aircraft Co , Long Beach, Calif) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 14th, Washington, D C , Feb 7-9, 1978, Paper 78-356* 7 p 16 refs

The NASA Supersonic Cruise Aircraft Research program has identified promising solutions to the noise, range, and economic problems which led to the cancellation of the previous U S supersonic transport research program However, the NASA program has not been large enough to prove that the solutions are viable Such proof requires large-scale development testing The results of the recent efforts are illustrated by examining the improvements obtained in a hypothetical airline aircraft Relative to the Concorde a 50-percent increase in range can be shown, which would open up practical, supersonic operations for the Pacific where distances are great and the savings in travel time are very large The aircraft payload could be significantly increased, shown here at 250 passengers, which directly improves operating economics G R

A78-24032 # **Fuels outlook I - Transportation and the U S petroleum resource, an aviation perspective** M P Miller and R A Mays (Boeing Commercial Airplane Co , Seattle, Wash) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 14th, Washington, D C , Feb 7-9, 1978, Paper 78-357* 11 p 24 refs

The U S commercial aviation industry is meeting the continuing challenges of reduced fuel consumption, higher fuel prices, and increased passenger traffic A disturbing fact is that the country has become increasingly dependent on imported petroleum fuels In the event that import restrictions are imposed or that some form of rationing is required, federal fuel-allocation policies should be based on an informed understanding of user characteristics This paper provides an overview of several facets of commercial aviation fuel consumption the merits of its public services, the conservation measures taken to date, the consequences of future shortages, energy conservation strategies, modal efficiency comparisons, and alternate fuel considerations The conclusion is reached that commercial aviation should be designated as a high-priority user of petroleum fuels in any government allocation program (Author)

A78-24033 # **Planning for the next generation aircraft - An airline view** D J Lloyd Jones (American Airlines, Inc , New York, N Y) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 14th, Washington, D C , Feb 7-9, 1978, Paper 78-361* 9 p

External factors such as fuel costs and government regulations, specifically, Part 36 noise requirements, play a decisive role in airline plans for aircraft procurement The American Airlines fleet is evaluated in terms of composition and profitability through the year 1984 In order to comply with Part 36, the airline has three options other than scrapping its 707's completely retrofit, re-engining, and gradual replacement of older aircraft types, i e outfitting the fleet with current wide-body aircraft Load factors and operating costs are analyzed, and new technologies, such as improved engines and composite-materials, are discussed as ways to increase profitability D M W

A78-24034 # **The challenge of advanced fuel-conservative aircraft - A manufacturer's view** R E Hage and J A Stern (Douglas Aircraft Co , Long Beach, Calif) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 14th, Washington, D C , Feb 7-9, 1978, Paper 78-362* 18 p

Costs and technological problems associated with advanced fuel-conservative aircraft are discussed, with particular attention given to the current NASA Aircraft Energy Efficiency (ACEE) program, which focuses on engine component improvement, turboprops, laminar flow control and composites In addition to the results of the ACEE program, aircraft manufacturers will need to deal during the next decade with the noise requirements established by FAR Part 36 Due to high costs and noise considerations, DC 8 and B707 fleets are expected to be replaced by the 1980s, and the demand for fuel-efficient aircraft in the 100- to 200-seat category will be significant Fuselage cross sections for such a category are considered, a comparison of the effectiveness of twin-jets and tri-jets for medium-range transport is also reported J M B

A78-24035 # **Prospects for a new generation air transport** J L McLucas (COMSAT General Corp , Washington, D C) *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 14th, Washington, D C , Feb 7-9, 1978, Paper 78-363* 7 p

The market for new technology airplanes is good and new designs will be offered in 1978 Airlines earnings are up but still inadequate for fleet replacement Legislation to permit ticket tax revenues to go to new aircraft purchase is likely as is limited regulatory reform Recent CAB flexibility on routes and fares is encouraging Both government and private actions to keep foreign markets open is essential Purchases of new airplanes sparked by traffic growth and replacement of 'non-complying' noisy aircraft can lead to $50B market over next decade (Author)

A78-24085 # **Successive-approximation calculation of a steady subsonic gas flow about an airfoil lattice (Raschet statsionarnogo obtekaniia reshetki profilei dozvukovym potokom gaza metodom posledovatel'nykh priblizhenii)** V P Riabchenko (Akademiia Nauk SSSR, Institut Gidrodinamiki, Novosibirsk, USSR) *Akademiia Nauk SSSR, Sibirskoe Otdelenie, Izvestiia, Seriia Tekhnicheskikh Nauk,* Oct 1977, p 11-15 6 refs In Russian

A78-24096 # **Calculation of the three-dimensional supersonic viscous heat-conducting gas flow past blunted bodies (Raschet prostranstvennogo obtekaniia zatuplennykh tel sverkhzvukovym potokom viazkogo i teploprovodiashchego gaza)** V E Kariakin and

F D Popov *Zhurnal Vychislitel'noi Matematiki i Matematicheskoi Fiziki,* vol 17, Nov Dec 1977, p 1545-1555 6 refs In Russian

Approaches to the numerical solution of the three-dimensional supersonic flow problem under consideration are studied, treating the shock wave as a discontinuity surface and assuming that the simplified Navier-Stokes equations containing only the terms of the inviscid-flow and boundary-layer equations are valid in the entire region of the flow Results of calculations of a M = 4 flow at an angle of 10 degrees past an ellipsoid of revolution with an axial ratio of 1 5 are analyzed, along with results obtained at Re = 3333, 1000, and 333 for the case of a heat-insulated surface and a surface with a given temperature V P

A78-24149 # **The start-up of a gas turbine engine using compressed air tangentially fed onto the blades of the basic turbine (Zapusk GTD szhatym vozdukhom, podvodimym tangentsial'no na lopatki osnovnoi turbiny)** L I Slobodianiuk and V I Daineko (Sevastopol'skii Priborostroitel'nyi Institut, Sevastopol, Ukrainian SSR) *Energetika,* vol 20, Sept 1977, p 135-137 In Russian

A78-24156 # *Steady-state bulk temperature field in cooled* **turbine blades (Ob'emnoe pole statsionarnykh temperatur v okhlazhdaemykh lopatkakh turbiny)** V I Lokai and E I Gunchenko (Kazanskii Aviatsionnyi Institut, Kazan, USSR) *Inzhenerno-Fizicheskii Zhurnal,* vol 33, Oct 1977, p 687 693 7 refs In Russian

It is shown how a Green's function can be used to calculate steady-state bulk temperature fields in bodies of complex configuration for variable boundary conditions and a temperature dependent heat-transfer coefficient The effectiveness of the method is demonstrated by comparing the surface and bulk temperature distributions (thermal state) calculated for a turbine blade employing combined convective and film cooling with the measured values V P

A78-24252 # **The effect of angle of attack on the aerodamping of wing profile vibrations (Vliianie ugla ataki na aerodempfirovanie kolebanii krylovykh profilei)** V B Avdeev *Aviatsionnaia Tekhnika,* vol 20, no 3, 1977, p 11-16 In Russian

Wind-tunnel vibration tests were performed on a turbine-blade-cascade model for flow velocities of M = 0-3 The method of determining the aerodamping characteristics of the model consisted of measuring the energy dissipation of forced resonant vibrations, first for the case without flow, then for flow with a constant level of resonant excitation Aerodamping was characterized by an aerodynamic vibration decrement It is found that there is no clear and singlevalued relationship between aerodamping and angle of attack B J

A78-24253 # **Theory of two frequency ranges of unstable oscillations of turbulent combustion in a jet-engine chamber I - Formulation of the stability problem, the characteristic equation (Teoriia dvukh chastotnykh diapazonov neustoichivykh kolebanii protsessa turbulentnogo goreniia v kamere reaktivnogo dvigatelia I - Formulirovka zadachi ob ustoichivosti, kharakteristicheskoe uravnenie)** S K Aslanov *Aviatsionnaia Tekhnika,* vol 20, no 3, 1977, p 17-22 7 refs In Russian

The theory of one-dimensional perturbations is used in formulating the problem of stability for averaged steadystate combustion in a jet-engine chamber The physical-chemical nature of the process are interpreted in the framework of time lag of evaporation and ignition, the boundary conditions are acoustic conditions at the entrance and exit of the chamber and conservation laws at the turbulent flame front with consideration of turbulent pulsations The mathematical problem is closed by means of two relations, obtained by varying the laws of turbulent combustion and kinetics of preflame processes An eigenvalue equation is derived, describing the stability of the combustion process B J

A78-24254 # **Thrust characteristics of thrust vector control systems with blowing injection of chemically nonreactive gases (Tiagovye kharakteristiki sistem UVT so vduvom khimicheski neitral'nykh gazov)** B S Vinogradov and Z G Shaikhutdinov *Aviatsionnaia Tekhnika,* vol 20, no 3, 1977, p 23-29 In Russian

The thrust characteristics of thrust vector control systems which employ secondary nonsymmetrical injection of gas into the supersonic jet-engine nozzle were determined experimentally Various test setups were used, distinguished by the type of working gas air, combustion products of air and kerosene, combustion products of air, kerosene and Al2O3, and combustion products of a solid fuel The effects of various structural and operational conditions on the thrust characteristics were determined by studying two major thrust parameters the gain coefficient and the quality coefficient B J

A78-24259 # **The effect of fluid oscillations in a fuel line on the pressure head of a pump operating in a regime without reverse streams (O vliianii kolebanii zhidkosti v toplivnoi magistrali na napor nasosa, rabotaiushchego na rezhimakh bez obratnykh tokov)** V G Kinelev *Aviatsionnaia Tekhnika,* vol 20, no 3, 1977, p 52-57 In Russian

Consideration is given to the effect of fluid self-oscillations in a fuel line on the pressure-head and cavitation flow characteristics of the pump These oscillations are conditioned by the formation of separated vortex regions in the screw pump As pressure drops in the pump entrance, vortex regions become visible due to the appearance of cavitation in the centers of the vortices that produce these regions Experimental data are examined for the case of a centrifugal screw-pump B J

A78-24273 # **Investigation of the inclination of nozzle blades on the alternating stress level in working turbine blades (Issledovanie vliianiia naklona soplovykh lopatok na uroven' peremennykh napriazhenii v rabochikh lopatkakh turbiny)** A A Kovalev, V A Strunkin, and I I Kurtseva *Aviatsionnaia Tekhnika,* vol 20, no 3, 1977, p 129-131 In Russian

A78-24274 # **Calculation of the thermal state of turbine blades with film cooling (K raschetu temperaturnogo sostoianiia turbinnykh lopatok s plenochnym okhlazhdeniem)** V I Lokai, E I Gunchenko, and A V Shchukin *Aviatsionnaia Tekhnika,* vol 20, no 3, 1977, p 132-135 11 refs In Russian

An analysis of experimental data is used to derive boundary conditions of the third kind (stipulating a local heat transfer coefficient for film cooling and an adiabatic wall temperature) for a turbine blade with film cooling These boundary conditions were used to calculate the thermal stress state (temperature distributions) for such a blade A comparison of computational and experimental results shows that recommendations in the literature on the establishment of boundary conditions for this problem are inadequate for calculating the thermal states of such blades with equired accuracy B J

A78-24275 # **Statistical evaluation of the effect of a jet reverser on the parameters of a turbofan engine in the direct thrust regime (Statisticheskaia otsenka vliianiia reversivnogo ustroistva na parametry TRDD na rezhime priamoi tiagi)** E D Nesterov, I I Plakhova, and E L Simkin *Aviatsionnaia Tekhnika,* vol 20, no 3, 1977, p 135-139 In Russian

A78-24346 **The Low-Level Wind Shear Alert Program** *Journal of Air Traffic Control,* vol 19, Oct -Dec 1977, p 5-7

The Low Level Wind Shear Alert System has been designed as part of the FAA Wind Shear program which was developed in response to a number of airline accidents that were probably caused by wind shear An analysis of such accidents revealed that substantial differences existed between the reported surface winds measured at centerfield and the surface winds existing in the approach and departure corridor It was concluded that the accidents might have been prevented if the pilots had received also prior information regarding the surface wind conditions in the approach and departure corridors The considered system has the objective to alert automatically the air traffic controllers whenever a vector difference of

greater than a predetermined value exists between the reported centerfield wind and the wind at any other anemometer on the airport surface The system was installed at six airports to verify the concept during the thunderstorm season of 1977 G R

A78-24347 Wake turbulence - Gone with the wind M Clark (FAA, Washington, D C) *Journal of Air Traffic Control,* vol 19, Oct-Dec 1977, p 10-12

In May 1976 a Vortex Advisory System (VAS) was installed at Chicago's O'Hare airport The VAS is based on wind measurements around the airport which make it possible to predict movement and behavior of aircraft generated wake vortices The VAS installation includes a network of meteorological towers sited near the middle marker locations The wind data from the anemometers on the towers are transmitted to a central computer The computer transmits through a digital display to the controller advising whether he can use reduced (3 n mi) separations in place of standard separation between arriving aircraft NASA has been engaged in an extensive research program for the aerodynamic alleviation of wake vortices Aerodynamic alleviation is a general term describing modifications to the aircraft or airfoil to alter the vortex structure and thereby minimize the adverse effects of the wake G R

A78-24356 A severe downslope windstorm and aircraft turbulence event induced by a mountain wave D K Lilly (National Center for Atmospheric Research, Boulder, Colo) *Journal of the Atmospheric Sciences,* vol 35, Jan 1978, p 59-77 17 refs

A detailed observational analysis is presented for the large-scale mesoscale, and especially the turbulent-scale features of the 11 January 1972 downslope windstorm in central Colorado, U S A Attention is focused on an analysis of the structure, dynamics and energy budget of the mid and upper tropospheric turbulence zone and to air safety in severe wave events It is shown that the mesoscale structure of the mountain wave and windstorm system have undergone an important oscillation in wavelength which is closely related to the question of where and how wave momentum flux is ultimately transported to the ground The 11 January wave is found to be exceptional because it involved a region of dynamically unstable shear in the middle troposphere The classical mechanism of shearing instability in the presence of stable thermal stratification is responsible for the generation of turbulence The observed large vertical motions and severe turbulence are demonstrated to be hazardous to aircraft, especially when unaware of the location of the principal wave and turbulence regions S D

A78-24364 # Turbulent airfoils for general aviation R Eppler (Stuttgart, Universitat, Stuttgart, West Germany) *Journal of Aircraft,* vol 15, Feb 1978, p 93-99 21 refs

Several new airfoils are presented which have short pieces of steep favorable pressure gradient followed by an early pressure recovery which is a compromise between the Stratford distribution and soft stall The drag polars are computed by a mathematical model, which is briefly described For comparison, NACA 65(2)-415 and NASA GA(W)-1 airfoils are evaluated using the same model, in this case the results are also compared with experimental drag polars (Author)

A78-24365 # Deployment forces in towing systems Y Narkis (Technion - Israel Institute of Technology, Haifa, Israel) *Journal of Aircraft,* vol 15, Feb 1978, p 123, 124 5 refs

A towing airplane usually climbs with a towed vehicle undeployed to a certain prescribed altitude where deployment takes place When the cable is fully extended, it experiences a sudden stretch due to the velocity difference between the airplane and the towed vehicle This stretch generates tension forces in the attachment point to the airplane that are much higher than in equilibrium flight In this note, an approximate solution is presented to the deployment forces in towing systems It is assumed that the entire deployment process occurs in a horizontal plane and that the cable is uniform, with linear elasticity and negligible tangential drag forces The peak stress in the cable during deployment is given by an equation where the final velocity at the end of the deployment process is unknown Two expressions are derived and presented graphically, showing that the final velocity tends quite sharply to an asymptotic value which determines an upper bound to the peak deployment stress S D

A78-24367 * # Comments on 'Feasibility study of a hybrid airship operating in ground effect' M D Ardema (NASA, Ames Research Center, Moffett Field, Calif) *Journal of Aircraft,* vol 15, Feb 1978, p 126, 127, Author's Reply, p 127, 128 9 refs

A78-24374 A study on the capacity of runway systems (Etude de la capacité des systèmes de pistes) F Collet and Y Breant *France Transports - Aviation Civile,* Winter 1977-1978, p 62-68 In French

Models of the operational parameters of civil-aviation runways are presented in terms of a runway's ability to handle airport traffic Runway capacity is defined as the amount of time a given number of aircraft have to spend on the runway waiting to take-off, and the amount of time spent in the air waiting to land A matrix of constraints is presented, together with a statistical analysis of average and peak-capacity waiting times Also discussed are construction, maintenance, and time-in-service factors as they pertain to runway use D M W

A78-24375 In-state delivery and reinforcement of rigid airport causeways - Some technical problems and attempts using special coatings (Remise en état et renforcement de chaussées rigides d'aérodromes - Quelques problèmes techniques et essais d'enrobés spéciaux) R Pech and G Burelle *France Transports - Aviation Civile,* Winter 1977-1978, p 69-72 In French

Airport causeways must have a high resistance to large capacity traffic, be able to retard cracks and fissures, be able to withstand severe changes in climate, and be easily maintained Comparisons are presented between standard asphalt causeways and causeways made from newer materials Epoxy-resins fulfill most design criteria, but are prohibitively expensive Asphalt combined with other materials, e g vinyls, kerosine derivatives, is found to offer the best alternative for causeway construction and repair, especially because it resists fissuring Two such combination materials are discussed in detail, Compo 1005 and Compoflex D M W

A78-24402 # Future development of commercial aircraft Technological challenge - Economic constraints (Kunftige Verkehrsflugzeugentwicklungen Technologische Herausforderung - Wirtschaftliche Zwange) H Hoppner (Vereinigte Flugtechnische Werke-Fokker GmbH, Bremen, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 10th, Berlin, West Germany, Sept 13-15, 1977, Paper 77-005* 33 p In German

The future development of commercial aircraft for European use is discussed with attention to technical and market factors It is thought likely that the maximum need for 120-160 passenger aircraft will occur before 1986, while the maximum need for wide-body aircraft (210 to 270 or more passengers) will occur in the 1983-1990 period Problems associated with the transition to wide-body aircraft are considered The annual growth of air traffic for the next ten years is estimated with attention to the mix of aircraft types that will be required Savings derived from technological advances and expenses associated with interest rates are estimated M L

A78-24404 # Problems of supersonic transport (Probleme des Uberschallverkehrs) U Ganzer (Berlin, Technische Universitat, Berlin, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 10th, Berlin, West Germany, Sept 13-15, 1977, Paper 77-007* 19 p 30 refs In German

Some of the main engineering problems encountered in the design of supersonic civil transport aircraft are mentioned, and their treatment in the design of the Concorde is briefly described The main part of the paper is then devoted to developing methods of characterizing the performance of the Concorde and the cost of its operations (Author)

A78-24410 **Wing with fork tips as means of increasing cost effectiveness of transport aircraft (Der Flugel mit Gabelspitzen als Mittel zur Erhohung der Wirtschaftlichkeit von Transportflugzeugen)** G Lobert (Messerschmitt-Bolkow-Blohm GmbH, Ottobrunn, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 10th, Berlin, West Germany, Sept 13-15, 1977, Paper 77-017* 47 p 7 refs In German (MBB-UFE-1344)

A method is described for discretizing the circulation distribution for planar and nonplanar lifting surfaces, and it is applied to a wing with fork tips This enables the induced drag for such a wing to be compared with that of a flat wing of equal washed surface and equal weight With a carefully designed fork tip, an 8% reduction in induced resistance can be obtained over the reference planar wing The savings in fuel weight and engine weight can amount to up to 7% of the useful load P T H

A78-24411 # **Navigation procedure - Present systems and development trends (Navigationsverfahren - Gegenwartige Systeme und Entwicklungstrends)** H Winter (Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt, Institut fur Flugfuhrung, Braunschweig, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 10th, Berlin, West Germany, Sept 13-15, 1977, Paper 77-018* 21 p 5 refs In German

At present, aircraft navigation and tracking is carried out by separate systems (VOR, DME, INS, Doppler Systems) Proposals for integrating these systems are discussed, together with a description of their shortcomings when used individually Attention is given to improvements in accuracy (using a Kalman filter), and better data links between ground stations and aircraft, e g DABS Microwave landing systems (MLS) and micro-electronics, which permit greater use of on-board systems, are also seen as improving navigation accuracy D M W

A78-24412 # **The technical potential of instrument landing systems in the present and in the future (Das technische Potential des Instrumenten-Landesystems in Gegenwart und Zukunft)** G Hofgen (Standard Elektrik Lorentz AG, Stuttgart, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 10th, Berlin, West Germany, Sept 13-15, 1977, Paper 77-019* 19 p In German

The basic principles of instrument landing systems (ILS) are described with reference to the usual frequencies of the ground based guiding transmitter, and the angle of approach around the mid-line of the runway The accuracy and dependability of ILS is discussed in terms of the stability and consistancy of both on-board and ground transmitting equipment Attention is given to the present state-of-the-art in ILS, and to suggestions for improvement, e g the use of two independent frequencies to reduce interference, and DME to improve distance measurement The use of a micro-wave landing system (MLS) is also discussed, but in general, ILS is considered sufficient for the present and short-term future D M W

A78-24414 # **Touch input as alternative to keyboard and rolling ball for the radar controller at the display-screen place of operation in ground-based flight control (Eine Beruhreingabe als Alternative zu Tastenfeld und Rollkugel des Radarlotsen am Schirmbildarbeitsplatz bei der bodenseitigen Flugfuhrung)** K -P Holzhausen and K P Gartner (Forschungsinstitut fur Anthropotechnik, Meckenheim, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 10th, Berlin, West Germany, Sept 13-15, 1977, Paper 77-021* 11 p 12 refs In German

A78-24417 **Design of a transonically profiled wing (Entwurf transsonisch profilierter Tragflugel)** B Kiekebusch (Messerschmitt-Bolkow-Blohm GmbH, Hamburg, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 10th, Berlin, West Germany, Sept 13-15, 1977, Paper 77-026* 75 p 45 refs In German (MBB-UM-12 77)

So-called 'organic' design criteria are combined with the isobar concept of wing design and applied to the optimization of a transonic wing Consideration is given to pre-optimization of wing aspect ratio and thickness, to design variations in the projection stage and to optimal structural weight and wing geometry Aerodynamic considerations in the realization of a thick wing profile are discussed along with aerodynamic profile-loading considerations and design stage monitoring of wing loading An isobaric concept of wing design is outlined followed by a description of aerodynamic design As an example, wing designs for the B10 and A300B airbuses are compared B J

A78-24418 # **Profile design for an advanced-technology airfoil for general aviation aircraft (Profilentwurf fur einen Tragflugel neuer Technologie fur Flugzeuge der allgemeinen Luftfahrt)** D Welte (Dornier GmbH, Friedrichshafen, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 10th, Berlin, West Germany, Sept 13-15, 1977, Paper 77-027* 25 p 5 refs In German Research supported by the Bundesministerium fur Forschung und Technologie

NACA profiles and a profile from the NASA General Aviation-Whitcomb series are used as a starting point in designing an advanced airfoil for general aviation aircraft Potential theory pressure distribution calculations, together with boundary layer calculations, permit a decrease in the null moment and an optimization of the lift characteristics of the wing Trailing edge flap design is also improved Wind tunnel tests are used to compare the conventional profiles, the NASA profile and the improved design J M B

A78-24419 **Wings with controlled separation (Flugel mit kontrollierter Ablosung)** W Staudacher (Messerschmitt-Bolkow-Blohm GmbH, Munich, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 10th, Berlin, West Germany, Sept 13-15, 1977, Paper 77-028* 28 p 22 refs In German (MBB-UFE-1343)

A description is presented of selected results obtained by a German study group concerned with investigations of wings with controlled separation The objectives of the investigation are related to an improvement of flight characteristics and flight performance limits in the region of large angles of attack by various techniques These techniques involve partly a generation of concentrated stable vortex systems which produce positive interference effects in relation to the wings The stabilization and the control of the separated vortex layers is also considered The studies conducted are concerned with the development of hybrid wings and the optimization of concentrated spanwise blowing Basic experimental data were obtained in wind tunnel tests. The effectiveness of strakes, flap systems, and spanwise blowing are compared G R

A78-24420 # **Basic considerations concerning the possibilities of wing families in civil aviation (Grundsatzbetrachtungen zur Moglichkeit von Flugelfamilien bei zivilen Verkehrsflugzeugen)** H -G Klug, B Fischer, and J Hempel (Messerschmitt-Bolkow Blohm GmbH, Hamburg, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 10th, Berlin, West Germany, Sept 13-15, 1977, Paper 77-029* 27 p In German

Economic considerations make a high degree of commonality among aircraft parts desirable Even for aircraft of widely differing range, capacity, and body type, common parts can be manufactured, although the task is made considerably easier when the aircraft is produced by the same company Tables are presented analyzing the performance parameters of different aircraft when fitted with a common (rather than an optimized) wing Although performance suffers slightly, this is more than offset by substantial savings in development and maintenance costs. D M W

A78-24421 # **The significance of wing end configuration in airfoil design for civil aviation aircraft (Die Bedeutung der Flugelendformen beim Tragflugelentwurf fur Flugzeuge der zivilen Luftfahrt)** H Zimmer (Dornier GmbH, Friedrichshafen, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 10th, Berlin, West Germany, Sept. 13-15, 1977, Paper 77-030* 41 p 31 refs In German Research supported by the Bundesministerium fur Forschung und Technologie

Lift dependent induced drag in commercial aviation aircraft is discussed, with emphasis on the necessary compromises between

wing end configuration modifications which better lift performance and the weight gains that accompany such modifications Triangular, rectangular and elliptical configurations for wing ends are considered, attention is also given to airfoil designs incorporating winglets Water tunnel tests of several configurations are reported In addition, applications of wing end modifications to advanced technology commercial aviation aircraft and to the Airbus A-300 are mentioned J M B

A78-24422 # **Aircraft performance improvement through retrofitting of winglets (Ein Beitrag zur Leistungsverbesserung von Flugzeugen durch Nachrusten von Winglets)** B Ewald (Vereinigte Flugtechnische Werke-Fokker GmbH, Bremen, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 10th, Berlin, West Germany, Sept 13-15, 1977, Paper 77-031* 41 p 9 refs In German

Wind tunnel tests are employed to study the lift performance improvements provided by the addition of winglets or additional span length to the VFW-614 wing profile In general the gain in lift is somewhat greater for the model with lengthened wing span, under conditions of constant lift, the winglet configuration reduces drag more effectively than the lengthened span model For typical landing and takeoff conditions, the lift gains provided by the two types of wing modification are approximately equivalent The effect of winglets of lateral maneuvering is also discussed J M B

A78-24425 # **Integrated flight control system for future transport aircraft (Integriertes Flugfuhrungssystem fur zukunftige Transportflugzeuge)** H Bohret (Bodenseewerk Geratetechnik GmbH, Uberlingen, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 10th, Berlin, West Germany, Sept 13-15, 1977, Paper 77-035* 18 p 7 refs In German

The paper discusses the increased requirements placed on the flight control and guidance systems of future transport aircraft, and describes the architecture of an integrated flight control system All functions will be distributed between two computers, the flight control computer and the flight management computer Sensor data are prepared in the sensor data management unit The reduced number of computer units in conjunction with a digital bus system will result in considerable savings in hardware costs An experimental system has been developed, which performs, besides the usual functions, such functions as TMA navigation, 4D navigation, and minimum noise approach A special pilot control unit designed as an intelligent terminal and having its own data processor and serial interface for exchange of data with controller is described P T H

A78-24426 **From analog to digital control systems - Improved performance by means of advanced technology (Von analogen zu digitalen Flugfuhrungssystemen-Leistungssteigerung durch eine fortschrittliche Technologie)** H Anders and K Weise (Messerschmitt Bolkow-Blohm GmbH, Hamburg, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 10th, Berlin, West Germany, Sept 13-15, 1977, Paper 77-036* 38 p 8 refs In German (MBB-UH-09-77)

Limitations of present-day analog flight control systems are characterized, and the potential for utilizing digital flight control systems for improved performance is discussed Prospective advantages of the digital system are thought to include cheaper electronic components, the processing of a larger number of computation steps, an increased accuracy, better error detection, fewer line replaceable limits, lower weight, and increased reliability Cost and the mean time between failures for analog and digital systems are compared M L

A78-24427 # **Mission management in the airport vicinity (Missionsmanagement im Flughafennahbereich)** A Modlinger (Vereinigte Flugtechnische Werke-Fokker GmbH, Bremen, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 10th, Berlin, West Germany, Sept 13-15, 1977, Paper 77-037* 27 p In German Research supported by the Bundesministerium fur Forschung und Technologie

Efforts concerning the development of more effective mission management procedures are related to predictions regarding an average yearly growth of the international air traffic of 7 9% A primary objective in this connection is the design of a digital integrated flight control system The automation of control processes within the terminal maneuvering area (TMA) for the approach phase is discussed together with the development of cost-effective flight procedures in the TMA Data for the fuel consumption as a function of the flight path angle are considered The optimal path angle found is 2 8 deg A description is presented of two different approach procedures, called TMA1 and TMA2 The TMA1 procedure provides an optimum approach with respect to fuel consumption The TMA2 program makes a four-dimensional navigation possible The described flight procedures were verified with the aid of a computer program Attention is given to the hardware configuration and the software of the considered flight control system G R

A78-24433 # **Advanced quiet propulsion for general aviation (Fortschrittliche leise Antriebe fur die Allgemeine Luftfahrt)** U Kramer (Vereinigte Flugtechnische Werke-Fokker, Bremen, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 10th, Berlin, West Germany, Sept 13-15, 1977, Paper 77-044* 51 p 11 refs In German

The problem of noise regulation applies to propeller craft as well as jets Demonstration flights with K- and E-class aircraft using motors generating up to 200 hp yielded noise reductions of 10 dB A reduction in the propeller's basic rate of rotation was also noted with the quieter engine, but an application of proven aviation-engineering principles should prove adequate to correct the problem Tables are presented outlining operating parameters of both present propeller systems and those still under development D M W

A78-24434 # **The integrated shielded propeller as a drive system for general aviation aircraft (Die integrierte Mantelschraube als Antriebssystem fur Flugzeuge der allgemeinen Luftfahrt)** H Fischer (Rhein-Flugzeugbau GmbH, Monchengladbach, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 10th, Berlin, West Germany, Sept 13-15, 1977, Paper 77-045* 27 p In German

The advantages of an integrated shielded propeller design are discussed In a comparison of shielded and free propellers it is shown that the cross section of the air stream behind the shielded propeller is not constricted An integrated shielded propeller was developed and used in power gliders, whose characteristics are reported, and in the design of a general aviation aircraft, which is described Advantages resulting from the use of the integrated shielded propeller include extension of the speed range, a reduction in noise level, and more comfortable cabin design M L

A78-24435 # **Special problems in the development of the propulsion system for an over-the-wing engine configuration (Spezielle Probleme bei der Entwicklung der Antriebsanlage fur eine Triebwerksanordnung uber dem Flugel)** R Smyth (Vereinigte Flugtechnische Werke-Fokker GmbH, Bremen, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 10th, Berlin, West Germany, Sept 13-15, 1977, Paper 77-046* 42 p In German

Problems related to over-the-wing engine design are discussed, with special reference to the development of the VFW-Fokker 614, a 40-passenger aircraft with a cruise speed of Mach 0 65 at an altitude of 25,000 ft Engine cycle selection, engine nacelle design, flow nozzle type and pylon configuration are considered Design of the intake profile is also considered Digital processing has been applied to the study of the engine performance in nonstationary flow with lateral wind components. J M B

A78-24436 # **Reducing aircraft noise through retrofitting (Senkung des Fluglarms durch Umrustung von Flugzeugen)** U Michel, D Bechert, and E Pfizenmaier (Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt, Institut fur Turbulenzforschung, Berlin, West Germany) *Deutsche Gesellschaft fur Luft- und*

Raumfahrt, Jahrestagung, 10th, Berlin, West Germany, Sept 13-15, 1977, Paper 77-047 16 p 21 refs In German

Retrofitting to reduce aircraft noise in aircraft such as the B727, B737, DC-9, and BAC-111 is discussed Data on the effects of retrofitting on noise emissions and performance are reported, re-engining, an option which will not be available for several years, is also mentioned Since noise reduction may be an expensive proposition, differential landing fees based on aircraft noise emission levels, as well as night-time restrictions on noisy aircraft, are suggested The example of Berlin is cited in urging a role for government in retrofitting J M B

A78-24437 # **Recent advances concerning an understanding of sound transmission through engine nozzles and jets (Neuere Erkenntnisse zum Schalldurchgang durch Triebwerksdusen und-Strahlen)** D Bechert, U Michel, and E Pfizenmaier (Deutsche Forschungs und Versuchanstalt fur Luft- und Raumfahrt, Institut fur Turbulenzforschung, Berlin, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 10th, Berlin, West Germany, Sept 13-15, 1977, Paper 77-048* 21 p 12 refs In German

Experiments on the interaction between a turbulent jet and pure tone sound coming from inside the jet nozzle are reported This is a model representing the sound transmission from sound sources in jet engines through the nozzle and the jet flow into the far field It is shown that pure tone sound at low frequencies is considerably attenuated by the jet flow, whereas it is conserved at higher frequencies On the other hand, broadband jet noise can be amplified considerably by a pure tone excitation Both effects seem not to be interdependent Knowledge on how they are created and on relevant parameter dependences allow new considerations for the development of sound attenuators (Author)

A78-24438 # **Localization and shielding of noise sources generated by the interaction of free jets with flat surfaces (Lokalisierung und Abschirmung der Schallquellen von Freistrahlen, die mit ebenen Platten interferieren)** E Evertz (Rheinisch-Westfalische Technische Hochschule, Aachen, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 10th, Berlin, West Germany, Sept 13-15, 1977, Paper 77-049* 20 p In German

Interaction of jet flows with the trailing edge flaps of advanced STOL aircraft is studied, with emphasis on reduction of the noise generated by the interaction Internal noise (due to fan, compressor, combustion chamber and turbine components), deflector noise, scrubbing noise, noise produced in the turbulent mixing layer, and the trailing edge noise are identified A system employing a hot wire probe and a microphone provides data on noise levels as a function of the length and orientation of the trailing edge element, frequency analysis of the jet noise is also reported J M B

A78-24439 **New methods for flight vibration studies (Neuere Methoden des Flugschwingungsversuchs)** G Haidl and M Steininger (Messerschmitt-Bolkow-Blohm GmbH, Ottobrunn, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 10th, Berlin, West Germany, Sept 13-15, 1977, Paper 77-050* 24 p 21 refs In German (MBB-UFE-1350)

In order to safeguard against flutter the flight vibration characteristics of aircraft should be determined, and a discussion of procedures for testing and evaluating flight vibration is presented Measurement and vibration-inducing devices, designed for attachment to aircraft, are described Analytical methods for processing flight vibration data are reported with attention to calculation of power spectra and frequency responses, probability of error in fast Fourier transforms, frequency and damping analysis from the impulse function, modal analysis, 'Randomdec signature' method, and window functions Test results are presented M L

A78-24441 # **Airframe noise, the lower noise limit for aircraft (Umstromungslarm, die untere Lärmgrenze fur Flugzeuge)** W F King (Deutsche Forschungs- und Versuchsanstalt fur Luft und Raumfahrt, Institut fur Turbulenzforschung, Berlin, West Germany) *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 10th, Berlin, West Germany, Sept. 13-15, 1977, Paper 77-052* 14 p 16 refs In German

Consideration is given to different mechanisms of airframe noise aerodynamic noise produced by turbulent flow past aircraft Airframe noise data are analyzed for eight different aircraft (HP 115, HS 125, BAC 1-11, VC 10, Libelle, Jet Star, Convair 990 and B-747) Optimal formulations of semiempirical equations were obtained for a model accounting for pure boundary layer noise and pure trailing edge noise Normalization of data showed the standard deviation for the boundary layer noise model to be negligible Using this model, a simple approximation formula was obtained for airframe noise The formula agreed well with experimental data on noise generated on the F-106B aircraft delta wing and on the Comet magnetic levitation vehicle B J

A78-24443 # **Use of the finite element method in fracture mechanics (Uber die Anwendung der Finite-Element Methode in der Bruchmechanik)** L Schwarmann and J Bauer (Vereinigte Flugtechnische Werke-Fokker GmbH, Bremen, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 10th, Berlin, West Germany, Sept 13-15, 1977, Paper 77-055* 26 p 17 refs In German

The use of the finite element method for calculating fracture mechanics parameters of a planar stringer- or rib-reinforced acircraft shell is described Example calculations which take into account the influence of the reinforcements and of the biaxial and variable stress-strain state are presented, and the theoretical basis of the method is considered The finite element method is recommended for complicated structures, when a structure is too complex for direct analysis an approximation method, such as the finite element method, can be used M L

A78-24448 # **The endangerment of flight safety due to wind shear (Die Gefahrdung der Flugsicherheit durch Scherwind)** P Krauspe (Braunschweig, Technische Universitat, Braunschweig, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 10th, Berlin, West Germany, Sept 13-15, 1977, Paper 77-062* 23 p 14 refs In German

Aircraft accidents due to wind shear at Boston (1973), New York (1975), and Denver (1975) are cited in discussing possible corrective measures The typical wind shear phenomena registered at airports is studied, and the dynamic response of aircraft structures to wind shear during the takeoff and landing phases is considered Adequate characterization of micrometeorological effects along airport runways, and the effective use of aircraft trailing edge flaps, spoilers, and direct lift control may provide greater safety during wind shear conditions J M B

A78-24451 # **Flowfield and pressure field of a model propeller (Stromungs- und Druckfeld eines Modellpropellers)** R Neubauer and K P Anders (Deutsche Forschungs- und Versuchsanstalt für Luft und Raumfahrt, Abteilung Technische Akustik, Braunschweig, West Germany) *Deutsche Gesellschaft fur Luft- und Raumfahrt, Jahrestagung, 10th, Berlin, West Germany, Sept 13-15, 1977, Paper* 10 p 10 refs In German

A schlieren technique is described for visualization of pressure gradients and flows in the near field of a reduced-scale propeller model Conventional and high-speed photography are used to record the schlieren images Schlieren films of the model propeller show that the two tip vortices of a two-blade propeller can move along paths of different radii, and also exhibit temporal fluctuations Such behavior in real propellers was verified P T H

A78-24460 # **Six degrees of freedom system for store separation studies in ONERA wind-tunnels** J Coste (ONERA, Châtillon-sous Bagneux, Hauts-de-Seine, France) *(Joint Technical Coordinating Group, Aircraft Stores Compatibility Symposium, 4th, Eglin AFB, Fla., Oct 12-14, 1977) ONERA, TP no* 1977 100, 1977 13 p

The study of airborne store separation can be performed in a wind tunnel by different methods In particular the 'grid' method, where aerodynamic loads are measured on the store placed suc-

cessively at discrete locations - grid nodes - in the aircraft aerodynamic field, the trajectory being then calculated by flight mechanics formulas, give fairly good results That kind of testing is currently carried out in Modane wind-tunnels for any military store Until now a sting support system with only one remotely controlled degree of freedom, i e , translation, was used But several manual operations were needed to modify the other, unmotorized, parameters of location and attitude Presently a device with six motorized, remotely controlled, degrees of freedom has been built, resulting in a significant time saving for such testing Associated with a computer controlled servo system, this device can be used not only with the grid method, but also with the captive trajectory method The mechanical features of the device and the bases for the servo control program are described, along with the first calibration results in the Modane 6 ft transonic tunnel (Author)

A78-24461 # **The ONERA position on the use of feed-back control against flutter due to external wing-mounted stores** R Dat, R Destuynder, and J -J Angelini (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France) *(Joint Technical Coordinating Group, Aircraft Stores Compatibility Symposium, 4th, Eglin AFB, Fla , Oct 12-14, 1977) ONERA, TP* no 1977-101, 1977 21 p 7 refs

Consideration is given to flutter control applicable to wing-mounted stores, noting that military aircraft carry a high number of store combinations Equations are derived for determining a flutter control law, including those describing the response of a wing in a flow to harmonic excitation The selective control of the flutter mode is discussed with reference to a control law modifying the damping of the unstable mode Nissim's method (1971) is reviewed in terms of providing a control dissipative matrix, and the dissipativity condition preventing the control matrix from providing active power is found Experiments in damping-out store-induced flutter on wind tunnel models are reviewed S C S

A78-24463 # **A new airfoil family for rotor blades** J -J Thibert (ONERA, Châtillon sous-Bagneux, Hauts de-Seine, France) and J Gallot (Societe Nationale Industrielle Aerospatiale, Division Helicopteres, Marignane, Bouches-du-Rhône, France) *(European Rotorcraft and Powered Lift Aircraft Forum, 3rd, Aix-en-Provence, France, Sept 7-9, 1977) ONERA, TP* no 1977-113, 1977 22 p 24 refs

The development and characteristics of the new OA 209 helicopter blade airfoil are described The airfoil, according to steady-flow wind-tunnel experiments and flight tests, has, in comparison with a conventional profile, an increased lift-to-drag ratio in hover, an increase in the flight envelope, a reduced level of vibration, and reduced pitch link loads Airfoil performance in steady airflow was predicted by computer programs for viscous transonic airflow Design objects, performance, and anticipated improvements are discussed M L

A78-24468 # **Study of a supercritical profile with oscillating control surface in sub- and transonic flows (Etude d'un profil supercritique avec gouverne oscillante en écoulement subsonique et transsonique)** R Grenon and J Thers (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France) *(NATO, AGARD, Symposium on Unsteady Aerodynamics, Ottawa, Canada, Sept 26-28, 1977) ONERA, TP* no 1977-136, 1977 11 p 6 refs In French

The paper presents results of unsteady pressure measurements performed on a supercritical profile equipped with a 25 percent-chord trailing edge control surface in harmonic motion, in two-dimensional sub- and transonic flows Important differences appeared between the subcritical regime without shock, and the supercritical regime with shock In both cases, we studied the influence of the 'unsteady' parameters, such as oscillation frequency and amplitude, and that of 'steady' ones, such as mean flap setting and wing angle of attack This study brought to light the importance of viscous and shock-related phenomena, and the necessity to develop calculation methods taking these phenomena into account (Author)

A78-24475 # **Aircraft electrical equipment (Elektrooborudovanie samoletov)** D N Sapiro Moscow, Izdatel'stvo Mashinostroenie, 1977 304 p 20 refs In Russian

Aircraft (including helicopter) electrical equipment is described with attention to the general characteristics required in equipment designed for use in aircraft Attention is directed to automatic control, electrical drive, illumination equipment, and heating equipment Other topics include power, switching, and electromagnetic devices, primary and secondary electrical sources, and circuit design M L

A78-24548 * **Service experience of composite parts on the L-1011 and C-130** R H Stone (Lockheed Aircraft Corp , Burbank, Calif) and W E Harvill (Lockheed-Georgia Co , General Structures Div , Marietta, Ga) *SAMPE Quarterly,* vol 9, Jan 1978, p 34-40 9 refs NASA sponsored research

Composite flight service programs are in progress on two aircraft, the L-1011 and C-130 A set of Kevlar-49/epoxy fairings is being flight tested on three L-1011's and have had no major service problems after 10,000 hours of service The center wing box aluminum skins and hat stiffeners were reinforced with precured bonded boron/epoxy strips on three C-130's After almost three years and over 4000 flight hours, these components are continuing to perform satisfactorily in service Another flight service component on the L-1011 is a graphite/epoxy floor post, which is free of service problems or defects after 10,000 flight hours These components provide significant verification of the serviceability of all three major composite reinforcement types (Author)

A78-24585 # **Organization of a programmed matrix-operation system in an airborne digital computer (Organizatsiia programmnoi sistemy matrichnykh operatsii na bortovykh TsVM)** V K Tomshin and V M Kharchenko *Upravliaiushchie Sistemy i Mashiny,* Sept -Oct 1977, p 70 74 In Russian

Fixed point procedures for the organization of programmed matrix operation in airborne computers are discussed Scaling difficulties are eliminated by the introduction of normalized matrices and scaling factor for matrices The matrix operation system has the following advantages (1) users are completely freed from the need to scale matrix operations, (2) the system is of high accuracy and enables organization of a flexible computational process, and (3) the programming of matrix operations is performed at the autocode level B J

STAR ENTRIES

N78-15991# Air Force Inst of Tech Wright-Patterson AFB Ohio School of Systems and Logistics
AN INVESTIGATION INTO THE NATURE OF AIRCRAFT SUPPORTABILITY IN THE CILC ENVIRONMENT M S Thesis
Gordon S Luna and Robert A Stier Sep 1977 128 p refs
(AD-A047226 AFIT-LSSR-13-77B) Avail NTIS HC A07/MF A01 CSCL 01/5

This paper deals with the initial development of a generalized model representing the Centralized Intermediate Logistics Concept (CILC) The model can handle from 1 to 10 operating locations and many of the logistical variables including demand rates, repair cycle times travel times and base repair rates The analysis includes a comparison of the traditional maintenance system to CILC and a trend analysis of the effects of demand rates base repair rates shipping times repair times and location strategy on supportability Author (GRA)

N78-15992# Air Force Inst of Tech Wright-Patterson AFB Ohio School of Systems and Logistics
AN ANALYSIS OF USER ACCEPTANCE AND PERCEIVED USABILITY OF C-141A JOB GUIDES M S Thesis
S A Richardson and Thomas E Syster Sep 1977 271 p refs
(AD-A047141 AFIT-LSSR-36-77B) Avail NTIS HC A12/MF A01 CSCL 05/9

The C-141A was the first aircraft to use job guides In 1976 AFHRL conducted a survey at the two bases which participated in the development of these job guides to determine their usability and degree of user acceptance This thesis conducted a similar survey at two bases which did not participate in the development of the C-141A Job Guide to determine if user attitudes about job guides was as favorable as found by AFHRL Also tests were made to determine if there was any difference in attitudes between pay grades Behavioral theory suggests that workers who participate in planning a change will have less resistance to that change and that younger workers resist change less than older workers It was concluded that technicians at bases which did not participate in the development of the C-141A Job Guides had a lower acceptance of them, but there was no difference in perceived usability No significant difference was found between grades for either user acceptance or perceived usability Although acceptance of the C-141A Job Guides was high actual on-the-job use of them appeared to be quite low and could eliminate anticipated cost savings as suggested by previous experiments with job guides Author (GRA)

N78-15993# Air Force Inst of Tech Wright-Patterson AFB Ohio School of Systems and Logistics
AN EVALUATION OF THE CAPABILITY OF THE LOGISTICS COMPOSITE MODEL TO PROJECT THE MONTHLY AIRCRAFT SORTIE EFFECTIVENESS OF AN F-15 WING M S Thesis
Charles G Davis and Clifford T Smith Sep 1977 103 p refs
(AD-A047227 AFIT-LSSR-2-77B) Avail NTIS HC A06/MF A01 CSCL 01/5

There has been considerable research on computerized generation of alternative flying and maintenance schedules in an effort to improve utilization of Air Force resources However no technique exists to evaluate the potential sortie effectiveness of alternative schedules The Logistics Composite Model (LCOM) appeared to have the potential to perform the evaluation through simulation The authors investigated LCOMs capability to accurately predict the sortie effectiveness of F-15 monthly flying schedules by simulating six actual F-15 monthly flying and maintenance schedules Analysis of the results indicated that LCOM could not effectively evaluate alternative F-15 monthly flying schedules Author (GRA)

N78-15995 Colorado Univ Boulder
NUMERICAL SOLUTION FOR SOME PROBLEMS CONCERNING UNSTEADY MOTION OF AIRFOILS Ph D Thesis
Yeou-Kuang Shung 1977 71 p
Avail Univ Microfilms Order No 77-24290

The unsteady behavior of a wing of infinite span moving through an inviscid and incompressible fluid is studied by using the method of conformal mapping in combination with a numerical technique When a small airplane is flying toward a line vortex left behind by a large aircraft, the lift and moment on the small airplane caused by the line vortex alone is computed Numerical results have been obtained for various combinations of the speed and the position of the small airplane relative to the center of the line vortex It is found that the small airplane may experience large fluctuations in both lift and moment when traversing through a strong line vortex Dissert Abstr

N78-15996 Illinois Univ Urbana-Champaign
ON SOME STRUCTURE-TURBULENCE INTERACTION PROBLEMS Ph D Thesis
Shoji Maekawa 1977 117 p
Avail Univ Microfilms Order No 77-26709

The interaction between a turbulent flow and certain types of structures responding to its excitation was studied The turbulence was typical of those associated with a boundary layer having a cross spectral density indicative of convection and statistical decay A number of structural models were considered in the investigation including an unsupported infinite beam and a periodically supported infinite beam The results are presented in terms of the spectral densities of the structural response and the perturbation Reynolds stress in the fluid at the vicinity of the interface It is found that important spectral peaks of the structural response will not appear if decays in the turbulence are neglected in the analysis Dissert Abstr

N78-15997 Georgia Inst of Tech Atlanta
AN IMPROVED METHOD OF CALCULATING THE TIP VORTEX GEOMETRY FOR HOVERING ROTORS Ph D Thesis
Satish S Samant 1976 73 p
Avail Univ Microfilms Order No 77-25615

Efforts were made to locate the cause of discrepancies in the performance analysis of hovering rotors Accurate specification of the geometry of the vortex wake particularly in the near wake was of primary concern The consistency requirement that the velocity in the blades fixed reference system at a point on the a vortex filament must be tangential to the vortex filament referred to the same system was developed in terms of the apparent velocity components It was shown that the apparent velocity components calculated from a given vortex system using the Biot-Savart law do not satisfy these consistency requirements but can be used to calculate the effect of the same vortex system at the blade very accurately The discrepancies in the induced velocity are therefore thought to be the local effects of this small region and are then called the core effect
Dissert Abstr

N78-15999*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
WIND-TUNNEL INVESTIGATION OF AERODYNAMIC PERFORMANCE, STEADY AND VIBRATORY LOADS, SURFACE TEMPERATURES, AND ACOUSTIC CHARACTER-
Nov 1976 153 p refs
(NASA-TN-D-8235 L-10753) Avail NTIS HC A08/MF A01 CSCL 01A

Static and wind-on tests were conducted to determine the aerodynamic characteristics of and the effects of jet impingement on the wing of a large scale upper surface blown configuration powered with an actual turbine engine The wing and flaps were instrumented with experimental dual-sensing transducer units consisting of a fluctuating pressure gage a vibratory accelerometer and a surface mounted alumel thermocouple Noise directivity and spectral content measurements were obtained for various flap configurations and various engine thrust settings to provide baseline noise data for other upper surface blown configurations A R H

N78-16000*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
LONGITUDINAL AERODYNAMIC CHARACTERISTICS AT MACH 0 60 TO 2 86 OF A FIGHTER CONFIGURATION WITH STRUT BRACED WING
Samuel M Dollyhigh William J Monta and Giuliana Sangiorgio Dec 1977 149 p refs
(NASA-TP-1102 L-11801) Avail NTIS HC A07/MF A01 CSCL 01A

An investigation was made to determine the effects on longitudinal aerodynamic characteristics of utilizing struts to brace the wing to allow the wing thickness reduction on the LFAX-8 fighter configuration Structural and load analysis indicated that the maximum airfoil thickness could be reduced from 4 5 to 3 1 percent with the strut brace concept Wave drag theory indicated that reducing the wing maximum thickness from 4 5 percent to 3 1 percent would yield a significant reduction in zero-lift wave drag of about 28 percent at the design Mach number of 1 60 Strut arrangements designed and tested included a single straight strut a single swept strut, and a set of tandem straight struts In addition a wire of approximately the same cross sectional area replaced the single straight strut on one series of runs The original LFAX-8 with the 4 5-percent-thick wing was retested to serve as a base line for this investigation Author

N78-16001*# National Aeronautics and Space Administration Lewis Research Center, Cleveland Ohio
COLD-AIR PERFORMANCE OF A TIP TURBINE DESIGNED TO DRIVE A LIFT FAN 3 EFFECT OF SIMULATED FAN LEAKAGE ON TURBINE PERFORMANCE
Jeffrey E Haas (Army R and T Labs) Milton G Kofskey Glen M Hotz, and Samuel M Futral Jr Jan 1978 28 p refs
(NASA-TP-1109 E-9331) Avail NTIS HC A03/MF A01 CSCL 01A

Performance data were obtained experimentally for a 0 4 linear scale version of the LF460 lift fan turbine for a range of scroll inlet total to diffuser exit static pressure ratios at design equivalent speed with simulated fan leakage air Tests were conducted for full and partial admission operation with three separate combinations of rotor inlet and rotor exit leakage air Data were compared to the results obtained from previous investigations in which no leakage air was present Results are presented in terms of mass flow, torque and efficiency Author

N78-16002*# Lockheed-California Co Burbank
A GENERALIZED VORTEX LATTICE METHOD FOR SUBSONIC AND SUPERSONIC FLOW APPLICATIONS
Luis R Miranda Robert D Elliot and William M Baker Dec 1977 371 p refs
(Contract NAS1-12972)
(NASA-CR-2865 LR-28112) Avail NTIS HC A16/MF A01 CSCL 01A

If the discrete vortex lattice is considered as an approximation to the surface-distributed vorticity then the concept of the generalized principal part of an integral yields a residual term to the vorticity-induced velocity field The proper incorporation of this term to the velocity field generated by the discrete vortex lines renders the present vortex lattice method valid for supersonic flow Special techniques for simulating nonzero thickness lifting surfaces and fusiform bodies with vortex lattice elements are included Thickness effects of wing-like components are simulated by a double (biplanar) vortex lattice layer, and fusiform bodies are represented by a vortex grid arranged on a series of concentrical cylindrical surfaces The analysis of sideslip effects by the subject method is described Numerical considerations peculiar to the application of these techniques are also discussed The method has been implemented in a digital computer code A users manual is included along with a complete FORTRAN compilation an executed case and conversion programs for transforming input for the NASA wave drag program Author

N78-16003*# Boeing Vertol Co , Philadelphia, Pa
TWO-DIMENSIONAL WIND TUNNEL TEST OF AN OSCILLATING ROTOR AIRFOIL, VOLUME 1 Final Report
L U Dadone Dec 1977 163 p refs
(Contract NAS1-13795)
(NASA-CR-2914 D210-11188-1-Vol-1) Avail NTIS HC A08/MF A01 CSCL 01A

A two dimensional wind tunnel test was conducted to obtain the quasisteady and unsteady characteristics of an advanced airfoil designed for helicopter rotor applications Differential pressures were measured at 17 locations along the chord of the airfoil model The airfoil motions were sinusoidal forced-pitch oscillations about the quarter chord at amplitudes varying from 2 5 to 10 0 degrees and at frequencies from 23 Hz to 90 Hz The quasisteady tests were conducted at Mach numbers from 0 2 to 0 9 and the oscillatory tests between M = 0 2 and M = 0 7 At quasisteady conditions a limited number of drag measurements were made with a wake-traversing probe Author

N78-16015*# Boeing Commercial Airplane Co Seattle Wash
FEASIBILITY STUDY OF AN INTEGRATED PROGRAM FOR AEROSPACE VEHICLE DESIGN (IPAD) VOLUME 5 CATALOG OF IPAD TECHNICAL PROGRAM ELEMENTS Final Report
W B Gillette ed and J W Southall ed 21 Sep 1973 364 p refs
(Contract NAS1-11441)
(NASA-CR-132395 D6-60181-5) Avail NTIS HC A16/MF A01 CSCL 01C

The catalog is presented of technical program elements which are required to support the design activities for a subsonic and supersonic commercial transport Information for each element consists of usage and storage information ownership status and an abstract describing the purpose of the element Author

N78-16021# Stevens Inst of Tech Hoboken N J
RESEARCH ON THE FLUTTER OF AXIAL-TURBOMACHINE BLADING
F Sisto Nov 1977 46 p refs
(Contract N00014-76-C-0540)
(AD-A047086 ME-RT-77004) Avail NTIS HC A03/MF A01 CSCL 01/3

The dynamic stall of an airfoil with leading edge bubble separation is analyzed The stall flutter of turbomachine blading often involves periodic growth and collapse of such a bubble The mathematical model representing the physical problem is presented A flat plate undergoing harmonic oscillations with time dependent point of re-attachment is studied for the perturbed aerodynamic reactions and applications to the stall flutter problem Author (GRA)

N78-16023# Naval Ship Research and Development Center Bethesda Md
THEORETICAL ASPECTS OF DROMEDARYFOIL Interim Report, Jan 1976 - Jan 1977
Tsze C Tai Nov 1977 39 p refs
(RR02302001)
(AD-A047150, DTNSRDC-77-0104) Avail NTIS HC A03/MF A01 CSCL 20/4

A new airfoil design (called a dromedaryfoil) has been developed using a single hump on a modified supercritical airfoil for limiting the center of pressure excursion and maximizing the drag divergence Mach number Derivation of the hump is based on isentropic compression in the fore part and incipient separation in the rear The former leads to a weakened shock wave and the latter to high pressure recovery after the shock The shock

will theoretically locate at the peak of the hump to form a fixed pressure pattern under different flight speeds The shock foot will be inclined at a deflection angle of the hump measured from the normal of the fore hump surface at the peak Theoretical results indicate considerably shorter center-of-pressure travel for a dromedaryfoil than for a supercritical airfoil with equal wave drag However improper humping would be penalized by increased wave drag At high supercritical flows the shock strength would be limited by (M sub 1 sin beta)max = 1 483 Experimental verification of theoretical predictions is planned Author (GRA)

N78-16024# Aircraft Research and Development Unit Laverton (Australia)
EVALUATION OF SLIMPACK STYLE PARACHUTE IN CT4A AIRTRAINER AIRCRAFT
Nov 1976 31 p refs
(AD-A047083 TI-556) Avail NTIS HC A03/MF A01 CSCL 01/3

The Slimpak style parachute was being evaluated under Technical Investigation 517 for use in place of the standard Flexible Back parachute which had proven unsatisfactory in helicopter operations when worn by large crew members Some instructors and students of No 1 Flying Training School of rather large build were unable to wear the Flexible Back parachute in the CT4A Airtrainer because of restriction to control column deflection Headquarters Support Command considered that the Slimpak style parachute might be suitable for use in the Airtrainer by the large crew memebers and ARDU was directed to investigate this possibility Ground and flight trials were conducted using a wide range of aircrew sizes Dropping trials were carried out under Technical Investigation 517 The Slimpak model parachute as tested was found to be unacceptable for use in the Airtrainer by aircrew with a buttock to heel length of less than about 1 02 m It was also found to have major deficiencies in design and operation of the harness and associated buckles that would render it unsuitable in its present form for use by the RAAF in any other aircraft Author (GRA)

N78-16025# Transportation Systems Center Cambridge Mass
AIRCRAFT WAKE VORTICES A STATE-OF-THE-ART REVIEW OF THE UNITED STATES R AND D PROGRAM Final Report, Oct - Dec 1976
J N Haddock ed and W R Eberle ed Feb 1977 349 p refs Prepared in cooperation with Lockheed Missiles and Space Co Huntsville Ala
(AD-A042442 TSC-FAA-77-4 FAA-RD-77-23) Avail NTIS HC A15/MF A01

A summary of the current state of-the-art understanding of the aircraft wake vortex phenomenon is presented and the results of the United States program to minimize the restrictions caused by aircraft wake vortices in the terminal environment are included The vortex phenomenon vortex avoidance systems and vortex alleviation techniques were also discussed Author (GRA)

N78-16026# Boeing Vertol Co , Philadelphia Pa
RESEARCH REQUIREMENTS TO IMPROVE SAFETY OF CIVIL HELICOPTERS
Kenneth T Waters Nov 1977 77 p refs
(Contract NAS1-13624)
(NASA-CR-145620) Avail NTIS HC A05/MF A01 CSCL 01C

Helicopter and fixed-wing accident data were reviewed and major accident causal factors were established The impact of accidents on insurance rates was examined and the differences in fixed-wing and helicopter accident costs discussed The state of the art in civil helicopter safety was compared to military helicopters Goals were established based on incorporation of known technology and achievable improvements that require development as well as administrative-type changes such as the impact of improved operational planning, training and human factors effects Specific R and D recommendations are provided with an estimation of the payoffs timing and development costs Author

N78-16027# Federal Aviation Administration Washington D C
TERMINAL AREA FORECAST 1978-1988
Jan 1977 355 p
(AD-A046543 FAA-AVP-77-17) Avail NTIS HC A16/MF A01 CSCL 01/2

This report contains forecasts for air carrier and air taxi enplanements air carrier and air taxi aircraft operations itinerant total and instrument aircraft operations and instrument approaches at 894 airports throughout the United States The airports in this publication include all those with Federal Aviation Administration air traffic control towers and those with air carrier service The report is intended as an aid for anticipating future manpower and equipment needs at terminal areas Author (GRA)

N78-16028# Transportation Systems Center Cambridge Mass
AIRLINE DELAY TRENDS, 1974-1975 A STUDY OF BLOCK TIME DELAYS, GROUND AND AIRBORNE, FOR SCHEDULED AIR CARRIERS Annual Report
Helen M Condell Seymour M Horowitz and Alan S Kaprelian Mar 1977 218 p
(AD-A039483, TSC-FAA-77-6 FAA-EM 77-2) Avail NTIS HC A10/MF A01 CSCL 01/2

Estimates of block airborne and ground delays for route segments flown by United States domestic scheduled airlines operating out of twenty large airports are presented in this document The data were determined from the CAB ER-586 Service Segment data base which provides monthly operational times both ground and airborne for all route segments receiving scheduled air carrier service The data in this report are limited to the three-hundred and thirty route segments connecting the twenty airports included in the study Average monthly estimates of the ground and airborne components of block delays defined as delays encountered from ramp to ramp on a route segment are presented for the two-year period from 1974-1975 Average monthly estimates of delays for the airborne portion of the segment wheel off to wheels on are categorized according to 1 Route segment 2 airline 3 aircraft type and 4 local scheduled arrival or departure time Average monthly estimates of delays for the ground portion of the route segments are categorized according to departure and arrival ground times at the twenty airport locations included in the study These estimates of ground delays are further categorized into busy time intervals 0700 - 2259 and dull time intervals 2300 - 0659 Author (GRA)

N78-16029# National Aviation Facilities Experimental Center Atlantic City N J
SIMULATION TESTS OF FLIGHT TECHNICAL ERROR IN 2D/3D AREA NAVIGATION (RNAV) USING A MULTIPLE WAYPOINT RNAV SYSTEM WITH AND WITHOUT A FLIGHT DIRECTOR SYSTEM Final Report, Nov 1975 - Jan 1977
Donald Eldredge Warren G Crook and William R Crimbring Oct 1977 101 p refs
(AD-A047246 FAA-NA-77-10) Avail NTIS HC A06/MF A01 CSCL 17/7

Six pilots participated in a series of flight simulation tests employing solo pilot techniques which were conducted in order to measure total system crosstrack (TSCT) and flight technical error using a multiple waypoint storage 2D/3D area navigation (RNAV) system The tests were designed to assess pilot performance as a function of the interexperimental variables (1) 2D RNAV mode versus 3D RNAV mode (2) flight director versus no flight director (3) insertion of an impromptu waypoint into a previously entered flight plan and (4) different route structures Performance was measured on the variables horizontal tracking, vertical tracking airspeed control and procedural performance Author

N78-16030# National Aviation Facilities Experimental Center, Atlantic City N J
INTERMITTENT POSITIVE CONTROL. PHASE 1 OPERATIONAL TEST AND EVALUATION Interim Report, Jul - Sep 1976
John W Goodwin Oct 1977 19 p refs
(AD-A047249 FAA-NA-77-12) Avail NTIS HC A02/MF A01 CSCL 17/7

In testing this interface the IPC algorithm was resident in the Digital Simulation Facility which simulated the operation of

a discrete address beacon system The test series was operationally oriented and did not consider such factors as program size loading factors or processing time The results of the tests reveal that the IPC controller alerts, consistency of commands readability of displayed information and method of displaying information to the controllers were acceptable The issuance of negative commands to aircraft presents a problem to the controllers in that negative phraseology is not utilized in the air traffic control system The alerting methods of IPC and conflict alert are similar but because of the critical timing of the IPC alert it was felt that a distinctly different alert for IPC should be utilized Author

N78-16031# Mitre Corp McLean Va
INITIAL COLLISION AVOIDANCE ALGORITHMS FOR THE BEACON-BASED COLLISION AVOIDANCE SYSTEM
J Clark and A McFarland Apr 1977 96 p refs
(Contract DOT-FA69NS-162)
(AD-A047254 MTR-7532 FAA-RD-77-163) Avail NTIS HC A05/MF A01 CSCL 17/7

A set of baseline collision avoidance algorithms are described which can be used as a point of departure for the development of final algorithms for the beacon-based collision avoidance system The algorithms were structured to permit great flexibility in an experimental environment, and incorporate a number of selectable options in the collision avoidance logic and in the display output One option permits the selection of either a passive mode logic or an active mode logic When the passive mode is selected other options allow horizontal positive or negative commands to be used In addition the display of positive or negative commands can be selected or suppressed and limit vertical rate commands can be selected for display independently of positive or negative commands Two types of intruder position data can also be selected for display The logic can drive three types of cockpit displays Author

N78-16032# Mitre Corp McLean Va METREK Div
ASSESSMENT OF THE PERFORMANCE OF AN ACTIVE ATCRBS MODE FOR BEACON COLLISION AVOIDANCE
N A Spencer Paul M Ebert and Leonard T Moses Dec 1977 132 p refs
(Contract DOT-FA69NS-162)
(AD-A047670 MTR-7645 FAA-RD-77-151) Avail NTIS HC A07/MF A01 CSCL 01/2

The active air traffic control radar beacon system mode of the beacon collision avoidance system (BCAS) was tested in a National Aviation Facilities Experiment Center (NAFEC) airborne test bed After conducting many flights for purposes of the system shakedown design refinement and the setting of parameters a series of detailed data collection flights was run The results of approximately 100 one-on-one aircraft encounters were presented in which the ability of BCAS to give a proper maneuver command was examined then results of one and one-quarter hours of data on targets-of-opportunity in the environment of the Washington D C TCA flights with a controlled target in the airspace near NAFEC were examined to explore the effects of antenna coverage A comparison was made between the results obtained in Washington those from NAFEC flights and those from simulated scenarios were fed into the operating processor Author

N78-16035# Stanford Telecommunications Inc McLean Va
THE SINGLE-SITE COLLISION AVOIDANCE SYSTEM (SS-CAS)
L Schuchman and R Orr 16 Sep 1977 151 p refs Sponsored in part by FAA
(Contract F04701-75-C-0239)
(AD-A045977 FAA-EM-77-8) Avail NTIS HC A08/MF A01 CSCL 17/7

SS-CAS is a unique beacon collision avoidance system which works in conjunction with the current and next generation air traffic control surveillance systems (ATCRBS and DABS) In its passive mode SS-CAS provides three dimensional positions of both user and target aircraft using beacon replies from only one ground-based DABS or ATCRBS interrogator Full collision avoidance service is provided in both the all-ATCRBS environment of today the all-DABS environment of tomorrow and the intervening transition period The ground and airborne equipments required are add-ons to the ground beacon and the airborne DABS units A two-way data link separate from, but compatible in format with the DABS data link provides the SS-CAS-Equipped aircraft with important site data A tracker capable of reading reliable tracks through ATCRBS synchronous garble is employed DABS replies arrive garble-free at the SS-CAS aircraft and are simple to track An active mode and multi-site usage capability are available for performance enhancement in identified special situations This report fully describes the SS-CAS concept as it functions in the all-ATCRBS, all-DABS and transition environments Author (GRA)

N78-16037# Transportation Systems Center, Cambridge, Mass
AIRPORT SURFACE TRAFFIC CONTROL VISUAL GROUND AIDS ENGINEERING AND DEVELOPMENT PLAN Interim Report, Jun 1975 - Oct 1976
F D MacKenzie Jan 1977 68 p refs
(AD-A038153 TSC-FAA-76-26 FAA-RD-77-16) Avail NTIS HC A04/MF A01 CSCL 01/5

The plan described in this document supports the overall program at the Transportation Systems Center to define, design develop and evaluate systems that meet the requirements of airport surface traffic control This plan is part of documentation supporting one aspect of the program, visual ground aids development There are twenty-four concerns with the present visual ground aids The concerns deal with the ability of the present system and its components to support taxiing operations in the lower visibility environment found during Category III conditions This report describes an engineering and development plan which will identify solutions for the concerns create the specifications for improved visual ground aids and lay the ground work for application in future Category III operations The management of the development process leading to major improvements in the present system is described The plan includes a schedule budget, milestones and evaluation criteria Author (GRA)

N78-16038# Transportation Systems Center, Cambridge, Mass
AIRPORT SURFACE TRAFFIC CONTROL TAGS PLANNING ALTERNATIVES AND COST/BENEFIT ANALYSIS Final Report, Dec 1975 - Mar 1976
Paul S Rempfer Jan 1977 51 p refs
(AD-A037790, TSC-FAA-76-23, FAA-RD-77-9) Avail NTIS HC A04/MF A01 CSCL 17/7

The findings of a cost/benefit analysis of the deployment of a new airport ground surveillance system TAGS (Tower Automated Ground Surveillance) are presented TAGS will provide a plan view display of aircraft on the airports taxiways and runways like ground surveillance radar (ASDE) but unlike ASDE, TAGS will perform in heavy precipitation and automatically acquire and display aircraft flight identity The findings indicate that a TAGS deployment of between four and nine systems is cost/beneficial The development plan system costs analysis approach and sensitivity analysis supporting the findings are provided Author (GRA)

N78-16040 Aeronautical Research Labs Melbourne (Australia)
STABILITY OF HELICOPTER SLUNG LOADS
N Matheson Aug 1976 59 p refs
(ARL/AERO-Note-364) Copyright Avail Issuing Activity

Recent developments and data available concerning the operation of helicopters with slung loads are reviewed In particular slung load aerodynamic instabilities vertical bounce and sling leg flapping are considered Methods for reducing these instabilities and procedures for extending the operating limits of a helicopter with different types of slung loads are discussed Author

N78-16041 Arizona State Univ , Tempe
SENSITIVITY ANALYSIS OF OPTIMAL FLIGHT TRAJECTORIES Ph D Thesis

Matthew Allison Nichols 1977 166 p
Avail Univ Microfilms Order No 77-25887

Aircraft performance sensitivity to variations in aerodynamic and atmospheric conditions was analyzed The energy state approximation was used to reduce the complexity of the aircraft equations of motion permitting the use of optimizing functionals determined from variational techniques The minimum time and minimum fuel trajectories were determined for the supersonic F-4 aircraft Having determined the performance under nominal conditions variations in aerodynamic terms and atmospheric conditions were introduced along the optimal trajectory It was found that aircraft flight time and fuel consumption are sensitive to variations in aircraft thrust, drag coefficients and weight *Furthermore, a hot day atmosphere increased flight time and* fuel consumption while a cold day atmosphere reduced flight time and fuel consumption Dissert Abstr

N78-16042*# National Aeronautics and Space Administration Langley Research Center, Langley Station Va
GEMPAK AN ARBITRARY AIRCRAFT GEOMETRY GENERATOR
Sharon H Stack, Clyde L W Edwards, and William J Small Dec 1977 167 p refs
(NASA-TP-1022 L-11666) Avail NTIS HC A08/MF A01 CSCL 01C

A computer program, GEMPAK has been developed to aid in the generation of detailed configuration geometry The program was written to allow the user as much flexibility as possible in his choices of configurations and the detail of description desired and at the same time keep input requirements and program turnaround and cost to a minimum The program consists of routines that generate fuselage and planar-surface (winglike) geometry and a routine that will determine the true intersection of all components with the fuselage This paper describes the methods by which the various geometries are generated and provides input description with sample input and output Also included are descriptions of the primary program variables and *functions performed by the various routines* The FORTRAN program GEMPAK has been used extensively in conjunction with interfaces to several aerodynamic and plotting computer programs and has proven to be an effective aid in the preliminary design phase of aircraft configurations Author

N78-16043*# Boeing Commercial Airplane Co Seattle Wash
STUDY OF METALLIC STRUCTURAL DESIGN CONCEPTS FOR AN ARROW WING SUPERSONIC CRUISE CONFIGURATION Final Report, Tasks 1 and 2
M J Turner and D L Grande Dec 1977 147 p refs
(Contract NAS1-12287)
(NASA-CR-2743, D6-42438-3) Avail NTIS HC A07/MF A01 CSCL 01C

A structural design study was made to assess the relative merits of various metallic structural concepts and materials for an advanced supersonic aircraft cruising at Mach 2 7 Preliminary studies were made to ensure compliance of the configuration with general design criteria integrate the propulsion system with the airframe select structural concepts and materials, and define an efficient structural arrangement An advanced computerized structural design system was used in conjunction with a relatively large complex finite element model for detailed analysis and sizing of structural members to satisfy strength and flutter criteria A baseline aircraft design was developed for assessment of current technology Criteria analysis methods and results are presented The effect on design methods of using the computerized structural design system was appraised, and recommendations are presented concerning further development of design tools development of materials and structural concepts and research on basic technology Author

N78-16044*# Bolt Beranek, and Newman, Inc Cambridge Mass
CHARACTERIZATION OF NONGAUSSIAN ATMOSPHERIC TURBULENCE FOR PREDICTION OF AIRCRAFT RESPONSE STATISTICS Final Report
William D Mark Dec 1977 138 p refs
(Contract NAS1-14413)
(NASA-CR-2913 Rept-3496) Avail NTIS HC A07/MF A01 CSCL 01C

Mathematical expressions were derived for the exceedance rates and probability density functions of aircraft response variables using a turbulence model that consists of a low frequency component plus a variance modulated Gaussian turbulence component The functional form of experimentally observed concave exceedance curves was predicted theoretically the strength of the concave contribution being governed by the coefficient of variation of the time fluctuating variance of the turbulence Differences in the functional forms of response *exeedance curves and probability densities also were shown to* depend primarily on this same coefficient of variation Criteria were established for the validity of the local stationary assumption that is required in the derivations of the exceedance curves and probability density functions These criteria are shown to depend on the relative time scale of the fluctuations in the variance the fluctuations in the turbulence itself and on the nominal duration of the relevant aircraft impulse response function Metrics that can be generated from turbulence recordings for testing the validity of the local stationary assumption were developed Author

N78-16045*# Gates Learjet Corp Wichita Kans
CONCEPTUAL DESIGN OF SINGLE TURBOFAN ENGINE POWERED LIGHT AIRCRAFT
F Samuel Snyder, C Gene Voorhees Allyn M Heinrich and Donald N Baisden Mar 1977 174 p refs
(Contract NAS2-9242)
(NASA-CR-151972) Avail NTIS HC A08/MF A01 CSCL 01C

The conceptual design of a four place single turbofan engine powered light aircraft was accomplished utilizing contemporary light aircraft conventional design techniques as a means of evaluating the NASA-Ames General Aviation Synthesis Program (GASP) as a preliminary design tool In certain areas disagreement or exclusion were found to exist between the results of the conventional design and GASP processes Detail discussion of these points along with the associated contemporary design methodology are presented Author

N78-16046*# Old Dominion Univ Norfolk Va School of Engineering
ANALYSIS OF SPREAD MULTI-JET VTOL AIRCRAFT IN HOVER Final Technical Report
Leroy F Albang and A Sidney Roberts Dec 1974 89 p refs
(Contract NAS1-11707)
(NASA-CR-155582, TR-74-T8) Avail NTIS HC A05/MF A01 CSCL 01C

An investigation of vertical takeoff and landing aircraft lift losses in hover was conducted to evaluate a method for a simplified test technique Three flat plate models were tested to determine their usefulness in predicting hover characteristics by comparing results between plate and three-dimensional models Data obtained for the plate models were correlated to three-dimensional results by the application of a geometrical equivalent height correction factor The correlation of plate and tunnel models indicated that lift losses in ground effect were essentially independent of the efflux characteristics for the engine simulators Author

N78-16047# Air Force Aero Propulsion Lab Wright-Patterson AFB Ohio
QUIET PROPELLER/ROTOR CONCEPT EVALUATION Final Technical Report, 1 Feb 1971 - 31 Oct 1976
Paul A Shahady, Craig A Lyon, Matthew H Chopin Mark S Ewing and Robert M McGregor Oct 1977 185 p refs
(AD-A047297, AFAPL-TR-77-56) Avail NTIS HC A09/MF A01 CSCL 01/3

This report describes an exploratory development program to experimentally evaluate the noise characteristics of several *quiet propeller configurations to determine the noise reduction* potential of various new designs Variables investigated include number of blades blade-to-hub phasing angles and blade length

Performance and acoustic tests were conducted on modified UH-1D helicopter tail rotor blades in a specially designed hub The hub allowed the spacing between each blade to be independently varied so that the effects of modulated blade spacing could be studied The configurations tested included a 9 33 ft diameter six-bladed baseline rotor the same rotor with 6% and 10% modulated blade spacing a six-bladed rotor with leading edge rakes a two-bladed rotor and several rotor configurations with unequal blade lengths on the hub Author (GRA)

N78-16048# RAND Corp Santa Monica Calif
A CRITIQUE OF AIRCRAFT AIRFRAME COST MODELS Interim Report
J P Large and K M S Gillespie Sep 1977 63 p refs
(Contract F49620-77-C-0023)
(AD-A047181 R-2194-AF) Avail NTIS HC A04/MF A01 CSCL 01/3

This document examines a sample of seven aircraft airframe cost models The intent is to determine whether the model output is reasonable over a broad range of inputs, what limitations should be noted and where one model might be preferable to the others The critique shows that all the models have some deficiencies and all should be used with caution The more recent models appear to be better than the older ones which may be taken as a sign of progress, but it is plain that more progress is needed Some of the lessons learned in this review may be helpful in pointing out how the next generation of aircraft airframe cost models could be improved Author

N78-16049# Boeing Aerospace Co , Seattle, Wash Military Airplane Development
SPECIFICATIONS FOR IDAMST SOFTWARE Final Technical Report, Apr - Jun 1976
David G Tubb Jul 1977 130 p refs
(Contract F33615-76-C-1099)
(AD-A047163 AFAL-TR-76-208-Vol-1) Avail NTIS HC A07/MF A01 CSCL 09/2

The objective of this program was to define the operational flight program and operational test program for an Integrated Digital Avionics System for the Medium STOL (IDAMST) airplane This effort is part of an Air Force Avionic Laboratory Program to specify a candidate avionics design based on DAIS technology The approach involved the development of software requirements derived from the system analysis of the hardware baseline and the operational analysis of the AMST mission The software requirements were developed into a specific IDAMST software design The design is described in terms of functional architectural and configurational characteristics The design documents consist of four Computer Program Development Specifications type B5 per MIL-STD-490 and MIL-STD-483 The IDAMST software design was based on DAIS architecture and adapted as required to meet the IDAMST requirements The DAIS architecture proved to be flexible allowing the design to be extended in IDAMST without major change The IDAMST system defined satisfies the functional and operational requirements of the AMST The design consists of a dual redundant processor with a reprogrammable backup processor Author (GRA)

N78-16050# Transportation Systems Center Cambridge Mass
GENERAL AVIATION AVIONICS STATISTICS 1974 Annual Report, CY 1974
Judith C Schwenk ed Aug 1977 116 p refs
(AD-A045209 TSC-FAA-77-11 FAA-MS-77-2) Avail NTIS HC A06/MF A01 CSCL 09/3

The primary objectives of this study were to (1) provide a framework for viewing the general aviation (GA) aircraft fleet which would relate airborne avionics equipment to the capability for an aircraft to perform in the National Airspace System and (2) within this framework to portray the types of aircraft common to the GA fleet in terms of descriptive information on the aircraft To provide the framework capability groups of avionics equipment were designed and translated into aircraft capability to perform certain functions in the airspace system Two types of groups evolved hierarchical groups consist of avionics equipment meeting FAA requirements for flying in different airspace segments in different conditions and for landing at different classes of airports non-hierarchical groups consist of avionics equipment which give an aircraft additional capability but which are not required equipment according to FAA regulations Once the framework was developed the GA fleet as represented by the 1974 Aircraft Statistical Master File was distributed among the capability groups and its characteristics were studied In addition individual capability groups were analyzed to discover subgroups of aircraft with homogeneous characteristics This report presents the methodologies used in the analyses statistical tables and other results Author (GRA)

N78-16051*# National Aeronautics and Space Administration Washington D C
INVESTIGATION OF THE JET-WAKE FLOW OF A HIGHLY LOADED CENTRIFUGAL COMPRESSOR IMPELLER Doctoral Dissertation
Dietrich Eckardt Jan 1978 194 p refs Transl into ENGLISH from Untersuchung der Strahl/Totwasserstromung hinter einem Hochbelasteten Radialverdichterlaufrad (West-Germany) 1977 p 1-227 Transl by Kanner (Leo) Associates Redwood City Calif Original Doc Prep by Rhein Westfael Technical School Aachen
(Contract NASw-2790)
(NASA-TM-75232) Avail NTIS HC A09/MF A01 CSCL 21E

Investigations aimed at developing a better understanding of the complex flow field in high performance centrifugal compressors were performed Newly developed measuring techniques for unsteady static and total pressures as well as flow directions and a digital data analysis system for fluctuating signals were thoroughly tested The loss-affected mixing process of the distorted impeller discharge flow was investigated in detail, in the absolute and relative system, at impeller tip speeds up to 380 m/s A theoretical analysis proved good coincidence of the test results with the DEAN-SENOO theory which was extended to compressible flows Author

N78-16052*# Fiber Science Inc Gardena Calif
FILAMENT-WINDING FABRICATION OF QCSEE CONFIGURATION FAN BLADES
Sam Yao Jan 1978 22 p
(Contract NAS3-20099)
(NASA-CR-135332) Avail NTIS HC A02/MF A01 CSCL 21E

The design and fabrication of twelve NASA-QCSEE type composite fan blades utilizing wet filament winding fabrication techniques is described All composite fibers were continuous and attached to the root end All components were formed bonded and co-cured in one molding process Advanced fiber materials used in the blade fabrication were Thornel-300 Carbolon Z-2-1 and Carbolon Z-3 graphite in an epoxy resin matrix Author

N78-16053*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
COLD-AIR PERFORMANCE OF FREE-POWER TURBINE DESIGNED FOR 112-KILOWATT AUTOMOTIVE GAS-TURBINE ENGINE 1 DESIGN STATOR-VANE-CHORD SETTING ANGLE OF 35 DEG
Milton G Kofskey and William J Nusbaum Jan 1978 23 p refs
(NASA-TP-1007 CONS/1011-12 E-8964) Avail NTIS HC A02/MF A01 CSCL 21E

A cold air extperimental investigation of a free power turbine designed for a 112-kW automotive gas-turbine was made over a range of speeds from 0 to 130 percent of design equivalent speeds and over a range of pressure ratio from 1 11 to 2 45 Results are presented in terms of equivalent power torque mass flow and efficiency for the design power point setting of the variable stator Author

N78-16054*# Pratt and Whitney Aircraft Group East Hartford Conn Commercial Products Div
AN ANALYTICAL STUDY OF THERMAL BARRIER COATED FIRST STAGE BLADES IN A JT9D ENGINE

William R Sevcik and Barry L Stoner Jan 1978 33 p refs (Contract NAS3-21033)
(NASA-CR-135360 PWA-5590) Avail NTIS HC A03/MF A01 CSCL 21E

Steady state and transient heat transfer and structural calculations were completed to determine the coating and base alloy temperatures and strains Results indicate potential for increased turbine life using thin durable thermal barrier coatings on turbine airfoils due to a significant reduction in blade average and maximum temperatures and alloy strain range An intepretation of the analytical results is compared to the experimental engine test data Author

N78-16055*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
A REVIEW OF NASA'S PROPULSION PROGRAMS FOR AVIATION
Warner L Stewart Harry W Johnson and Richard J Weber 1978 21 p refs Presented at the 16th Aerospace Sci Meeting Huntsville Ala 16-18 Jan sponsored by AIAA
(NASA-TM-73831) Avail NTIS HC A02/MF A01 CSCL 21A

A review of five NASA engine-oriented propulsion programs of major importance to civil aviation are presented and discussed Included are programs directed at exploring propulsion system concepts for (1) energy conservation subsonic aircraft (improved current turbofans advanced turbofans and advanced turboprops) (2) supersonic cruise aircraft (variable cycle engines) (3) general aviation aircraft (improved reciprocating engines and small gas turbines) (4) powered lift aircraft (advanced turbofans) and (5) advanced rotorcraft Author

N78-16056# Purdue Univ Lafayette Ind
PROJECT SQUID Semiannual Progress Report, 1 Apr - 30 Sep 1977
T C Adamson, F Browand, Edgar P Bruce Franklin Carta, and A Dean 1 Oct 1977 100 p refs Prepared by MIT Cambridge
(Contract N00014-75-C-1143 Proj SQUID)
(AD-A047076) Avail NTIS HC A05/MF A01 CSCL 20/4

Progress on 20 research programs comprising Project SQUID are presented The research programs fall into the areas of Aerodynamics and Turbomachinery, Combustion and Chemical Kinetics Measurements and Turbulence Project SQUID is a cooperative program of basic research related to jet propulsion GRA

N78-16057# Air Force Inst of Tech Wright-Patterson AFB Ohio
A METHODOLOGY FOR ESTIMATING THE ECONOMIC BENEFITS OF AN AIRCRAFT ENGINE WARRANTY M S Thesis
Martin P Dooley and Richard E Kells Sep 1977 135 p refs
(AD-A047282, AFIT-LSSR-10-77B) Avail NTIS HC A07/MF A01 CSCL 14/1

Aircraft engine warranties are used extensively in the commercial airlines industry If the Department of Defense hopes to use warranties as a method of reducing engine life cycle costs the costs and benefits of each warranty must be carefully analyzed The methodology developed in this study provides framework to assist analysts in estimating the economic benefits of an engine warranty A test application of the methodology details the benefits of a hypothetical DOD engine warranty, and includes a sensitivity analysis of the key variables The study concludes that the basic method can be used to estimate the economic benefits of a wide range of engine and equipment warranties Author (GRA)

N78-16058# Strategic Air Command, Offutt AFB Nebr Aircraft Engineering Div
TF-30-P-7 INSTALLED TRIM CORRECTION Engineering Report, Aug 1973 - Jan 1977
James L Pettigrew 14 Jan 1977 70 p refs
(AD-A047023, SAC/LGME-ER-P-206) Avail NTIS HC A05/MF A01 CSCL 21/5

This report summarizes the findings from engineering tests conducted to determine causes of observed TF30-P-7 engine performance shift during operation of the FB-111A aircraft Details of the test conducted at Pease AFB during September 1974 are given along with analysis of the data by P/WA GD/FW, and Hq SAC/LGME Measurement of ambient temperature instrument uncertainty in the trim procedure, and assumption of constant inlet operation for simplification were found to be the prime causes of the apparent performance or trim shift Recommendations for improvement are given Author (GRA)

N78-16059# Bolt Beranek, and Newman Inc Canoga Park, Calif
PHYSICAL ANALYSIS OF THE IMPULSIVE ASPECTS OF HELICOPTER NOISE Final Report
William J Galloway Apr 1977 394 p refs
(Contract WI-77-3683-1)
(AD-A039715, BBN-3425, FAA-EQ-77-8) Avail NTIS HC A17/MF A01 CSCL 01/3

An evaluation is made of several helicopter flyover noise calculation schemes intended to describe signal impulsive character These schemes were proposed by ICAO member organizations Data are presented for various recorded flyovers and for simulations of helicopter flyovers Author (GRA)

N78-16061 *Stanford Univ, Calif*
UNSTEADY AERODYNAMIC MODELING AND ACTIVE AEROELASTIC CONTROL Ph D Thesis
John William Edwards 1977 209 p
Avail Univ Microfilms Order No 77-25659

Unsteady aerodynamic modeling techniques are developed and applied to the study of active control of elastic vehicles The problem of active control of a super-critical flutter mode poses a definite design goal--stability and is treated in detail The transfer functions relating the arbitrary airfoil motions to the airloads are derived from the Laplace transforms of the linearized airload expressions for incompressible two-dimensional flow The transfer function relating the motions to the circulatory part of these loads is recognized as the Theodorsen function extended to complex values of reduced frequency, and is termed the generalized Theodorsen function A brief critique of previous attempts to generalize the Theodorsen function is given Inversion of the Laplace transforms yields exact transient airloads and airfoils motions Exact root loci of aero-elastic modes are calculated providing quantitative information regarding subcritical and supercritical flutter conditions Dissert Abstr

N78-16062*# National Aeronautics and Space Administration Ames Research Center, Moffett Field Calif
AERODYNAMIC CHARACTERISTICS OF AN F-8 AIRCRAFT CONFIGURATION WITH A VARIABLE CAMBER WING AT MACH NUMBERS FROM 1 5 TO 2 0
Frederick W Boltz Dec 1977 70 p
(NASA-TM-73271, A-7141) Avail NTIS HC A04/MF A01 CSCL 01C

A 0 1-scale model of an F-8 aircraft was tested over a range of Mach numbers from 1 5 to 2 0 Reynolds number of 4 12 million was based on wing mean-aerodynamic chord for angles of attack varying from -2 deg to +12 deg The model was equipped with an advanced-technology-conformal-variable-camber wing (ATCVCW) having simple hinge flaps Data were also obtained for the model equipped with the basic F-8 wing and conventional flaps Model variables included aileron and wing trailing edge deflections and horizontal tail incidence The ATCVCW configuration produced slight improvements in lift-curve slope drag and static longitudinal stability over that of the basic F-8 wing configuration Flap effectiveness was essentially the same for both wings Author

N78-16063*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif
STUDY OF THE APPLICATION OF AN IMPLICIT MODEL-FOLLOWING FLIGHT CONTROLLER TO LIFT-FAN VTOL AIRCRAFT
Vernon K Merrick Nov 1977 180 p refs
(NASA-TP-1040 A-6712) Avail NTIS HC A09/MF A01 CSCL 01C

An implicit model-following flight controller is proposed This controller is relatively simple in concept it provides an input/output relationship that is approximately that of any selected second order system, it provides good gust alleviation and it is self-trimming The flight controller was applied to all axes of a comprehensive mathematical model of a lift-fan V/STOL transport Power management controls and displays were designed to match the various modes of control provided by the flight controller A piloted simulation was performed using a six degree of freedom simulator The fixed-operating-point handling qualities throughout the powered lift flight envelope received pilot ratings of 3-1/2 or better Approaches and vertical landings in IFR zero-zero conditions received pilot ratings varying from 2-1/2 to 4 depending on the type of approach and weather conditions Author

N78-16064*# Colorado Univ Boulder
DESIGN OF NONINTERACTING FLIGHT CONTROL SYSTEMS IN THE PRESENCE OF LARGE PARAMETER VARIATIONS Final Report, 1 Jul 1975 - 30 Nov 1977
Frank S Barnes Nov 1977 86 p refs
(Grant NsG-1213)
(NASA-CR-155589) Avail NTIS HC A05/MF A01 CSCL 01C

The effects of system parameter variations on the over-all system stability were considered Results from the application of numerical minimization to reduce system coupling are given and some future research directions are outlined Author

N78-16065# Dynamic Controls Inc , Dayton Ohio
RESEARCH AND DEVELOPMENT OF AIRCRAFT CONTROL ACTUATION SYSTEMS THE DEVELOPMENT OF A DIRECT DRIVE FLY-BY-WIRE FLIGHT CONTROL SYSTEM AND EVALUATION OF A FORCE SHARING FLY-BY-WIRE ACTUATOR Final Report, Feb 1975 - Jun 1977
Gavin D Jenney Sep 1977 216 p
(Contract F33615-75-C-3068)
(AD-A047283, AFFDL-TR-77-91) Avail NTIS HC A10/MF A01 CSCL 01/4

This report describes the design and test evaluation of a direct drive fly-by-wire redundant control system Also included in the report is the evaluation testing of a fly-by-wire tandem actuator mechanization developed by Parker-Hannifin Aerospace Hydraulics Division Irvine California The direct drive system is based on using moving coil force motors to position a hydraulic control valve without hydraulic amplification The system is designed as a single fail operate system which will accept one input or component failure and continue to operate with acceptable performance The test results verified that the failure modes and performance met the design goals The system incorporates component dispersion techniques to allow single hit survivability The direct drive mechanization offers adequate performance with minimum complexity as a fly-by-wire control system The Parker-Hannifin actuator mechanization is a two fail operate configuration using an integrated secondary actuator with both force and position summing The test results document the operational characteristics of the design Author (GRA)

N78-16066*# Douglas Aircraft Co , Inc Long Beach Calif
EXPANSION OF FLIGHT SIMULATOR CAPABILITY FOR STUDY AND SOLUTION OF AIRCRAFT DIRECTIONAL CONTROL PROBLEMS ON RUNWAYS, APPENDIXES
J A McGowan 20 Jan 1978 224 p refs
(Contract NAS1-13981)
(NASA-CR-145281) Avail NTIS HC A10/MF A01 CSCL 14B

The models used to implement the DC-9-10 aircraft simulation for the Runway Direction Control study are presented The study was done on the Douglas Aircraft six-degree-of-freedom motion simulator Documentation of the models was in algebraic form, to the extent possible Effort was directed toward presenting what was actually done rather than general forms Author

N78-16067# SRI International Corp Menlo Park Calif All Weather Landing Systems
PILOTED FLIGHT SIMULATOR STUDY OF LOW-LEVEL WIND SHEAR, PHASE 2 Interim Report, Aug 1976 - Mar 1977
W B Gartner D W Ellis W H Foy M G Keenan A C McTee and W O Nice Mar 1977 189 p refs
(AD-A047251 FAA-RD-77-157) Avail NTIS HC A09/MF A01 CSCL 01/3

Task 2 of the All-Weather Landing Systems project is concerned with piloted flight simulation tests of various techniques designed to aid the pilot to detect and cope with low level wind shear on approach and landing The operational situation of a DC-10 aircraft landing in Category 1 visibility with ILS guidance was simulated Wind corresponding to inversion-layer frontal thunderstorm and no-shear conditions were simulated to provide test profiles The baseline aiding concept was the conventional DC-10 manual approach management The aiding concepts tested were based on ground speed displays (first experiment) flight path angle (second), and modified (acceleration-augmented) flight director (third experiment) Author

N78-16068# Naval Civil Engineering Lab , Port Hueneme, Calif
EXPERIMENTAL RELATIONSHIPS BETWEEN MODULI FOR SOIL LAYERS BENEATH CONCRETE PAVEMENTS Final Report, Jun 1975 - Jan 1976
J B Forrest P S Springston M G Katona, and J Rollins Jun 1977 245 p refs
(Contract DOT-FA74WAI-487)
(AD-A046239/0 FAA-RD-76-206) Avail NTIS HC A11/MF A01 CSCL 01/5

Two subgrades and four rigid pavement test sections were constructed and instrumented to recover experimental information of soil/rigid pavement behavior static loadings Pavement deflections and pavement/soil strain data were recorded for incremental static loads applied to a 30 inch diameter steel plate Tests were conducted for comparison of experimentally collected data with Westergaard and elastic layer analyses of the test sections to investigate whether a consistent mathematical relationship exists between the two methods of analysis To this end material characterizations were carried out for the component materials in the four different pavement sections and analytically predicted and experimentally obtained response data were compared Author

N78-16069# Naval Postgraduate School, Monterey, Calif
EVALUATION OF AND OPERATIONAL PROCEDURES FOR A HELICOPTER SIMULATION SYSTEM UTILIZING AN INTEGRATED ELECTRONIC INSTRUMENT DISPLAY M S Thesis
William Woodrow Fetzer Jr Jun 1977 89 p refs
(AD-A047166) Avail NTIS HC A05/MF A01 CSCL 01/4

This report discusses the evaluation and documentation of an integrated electronic instrument display designed to investigate stability and control of a helicopter during precision hover operations The equations of motion developed from the Kaman SH-2F Seasprite helicopter were implemented by a hybrid computer system and displayed by a graphics processor A complete procedural checklist including troubleshooting methods, is included in this report This helicopter simulation system can be used for further research in the development of optimal heads-up display configurations as well as analyses of instability caused by pilot induced oscillations in the hover flight regime Author (GRA)

N78-16070# Air Force Inst of Tech Wright-Patterson AFB, Ohio School of Systems and Logistics
AN ASSESSMENT OF RELEVANT DECISION MAKING FACTORS FOR ORGANIC VERSUS CONTRACT MAINTENANCE OPTIONS ON USAF FLIGHT SIMULATORS M S Thesis
Ronald J Arceneaux and George E Farsshman, Jr Sep 1977 137 p refs
(AD-A047136 AFIT-LSSR-7-77B) Avail NTIS HC A07/MF A01 CSCL 05/1

Since the maintenance on flight simulators is reportably manpower intensive, the use of contract maintenance is often

suggested A taxonomy of relevant decision making factors was not available for the maintenance manager s use when evaluating the alternatives of contracting for maintenance or maintaining an organic capability This research effort has identified some relevant decision making factors for a maintenance manager to consider when addressing the issue of contract maintenance versus organic maintenance at the organizational and intermediate level The data were obtained from open-end interviews on which an analysis was performed utilizing a technique of behavioral research called semantic content analysis The data analysis allowed for a determination of the relevant decision making factors and the subsequent recommendations on the development of a contract maintenance decision tree network Basically this decision tree would allow a manager to evaluate the options of contract maintenance versus organic maintenance making a determination of which is optimal for the given situation The factors identified by this research are considered to be cost drivers of the applicable maintenance option Author (GRA)

N78-16071# Naval Postgraduate School Monterey, Calif
AN EVALUATION OF THE FIDELITY OF MOTION SIMULATORS USING A MODEL OF HUMAN DYNAMIC ORIENTATION M S Thesis
Richard G Fuller Sep 1977 94 p refs
(AD-A047120) Avail NTIS HC A05/MF A01 CSCL 06/16

A deterministic simulation using a model of human dynamic orientation was written to optimize the parameters of the motion base control system for a six-degree-of-freedom flight simulator An experiment requiring pilots to rate different levels of motion fidelity during a basic flight task provided a data base for validation of the simulation Ratings between subjects for linear, rotational and combined motion cues were inconsistent due in part to the subjects lack of experience in the F-15 aircraft and proficiency in high performance aircraft The coefficient of concordance among subjects for the three ratings were 4483 4835 and 5914 respectively Comparison of simulation results with experimental data yielded positive correlations as high as 5138 Response of the simulation to changing wash-out filter parameters was investigated and found to be adaptable to experimental optimization methods Author (GRA)

N78-16072# Calspan Corp Buffalo N Y
WIND TUNNEL MODEL STUDY OF THE HOT EXHAUST PLUME FROM THE COMPRESSOR RESEARCH FACILITY AT WRIGHT-PATTERSON AIR FORCE BASE, OHIO Final Report, May 1976 - Jun 1977
Gary R Ludwig Oct 1977 59 p refs
(Contract F33615-76-C-2092)
(AD-A047205 CALSPAN-XE-5933-A-101 AFAPL-TR-77-58) Avail NTIS HC A04/MF A01 CSCL 13/2

This report presents the results of a wind tunnel model study to determine temperatures at various locations generated by the hot exhaust air from the Compressor Research Facility (CRF) which is being built at Wright-Patterson Air Force Base Ohio The study was designed to provide data at the inlet to the CRF and at other nearby locations where pedestrians building ventilation systems and vegetation might be affected The test program which was conducted in the Calspan Atmospheric Simulation Facility included flow visualization studies and quantitative concentration measurements of a tracer gas from which full-scale temperatures could be calculated The concentration measurements were performed for a number of wind speeds at each of twelve different wind directions Two exhaust flows and two exhaust stack configurations were studied Author (GRA)

N78-16073# Naval Research Lab Washington D C
DESIGN STUDY OF A CENTERPLATE MOUNT FOR WIND TUNNEL MODELS M S Thesis
Robert Wayne Russell Jun 1977 114 p refs
(AD-A047204) Avail NTIS HC A06/MF A01 CSCL 14/2

A three-strut wind-tunnel model support system was being used with an electrical balance in the 3 5 by 5 0 foot Department of Aeronautics low-speed wind tunnel The traditional method of image systems and alternate inverted mounting for the evaluation of aerodynamic tares was considered impractical for implementation in the small sized tunnel The design and installation of an alternate model support system using a centerplate mount was accomplished An aerodynamic evaluation for comparing the two model mounting concepts was performed via experiments with a single calibration wing Additionally these experiments were the first operational exercise of a recently developed microprocessor data acquisition system Author (GRA)

N78-16074# Federal Aviation Administration, Washington, D C Office of Aviation System Plans
REMOTENESS-COMPENSATION METHODOLOGY FOR BENEFIT/COST ESTABLISHMENT AND DISCONTINUANCE CRITERIA Final Report
Jan 1977 55 p
(AD-A043836, FAA-ASP-76-7) Avail NTIS HC A04/MF A01 CSCL 01/5

This report develops a procedure for adjusting the benefit/cost (B/C) ratios by which proposals for FAA terminal facilities in remote locations are evaluated The procedure is applicable to the types of installations for which B/C analyses, based on nationwide average data are incorporated in Airway Planning Standard Number One (FAA Order 7031 2B) Without such an adjustment, proposals for facilities in Alaska and other such locations could not realistically be compared with those for facilities in the contiguous 48 states (CONUS) The compensatory methodology first adjusts construction and installation costs according to a geographically differentiated index Staff housing cost is subtracted Exceptional site-preparation and other cost elements are not discarded but their cost is made equivalent to the cost of doing the same work at a corresponding CONUS site Next for facilities to serve remote communities shown to be exceptionally reliant on air transportation, the ascribed benefits are adjusted upward This benefit enhancement is proportional to the communities aviation-dependency as determined by the model contained in this report but it is not permitted to more than double intrinsic benefits The benefit-enhancement premium is earned by a relatively few sites where large numbers of citizens are without alternative transportation links to the outside world for extended periods Author (GRA)

N78-16075# Federal Aviation Administration Washington, D C Office of Aviation System Plans
ESTABLISHMENT OF NEW MAJOR PUBLIC AIRPORTS IN THE UNITED STATES
Aug 1977 140 p
(AD-A046462, FAA-ASP-77-3) Avail NTIS HC A07/MF A01 CSCL 01/5

This study was performed in response to Section 26(2) of the Airport and Airway Development Act Amendments of 1976 (Public Law 94-353) which directed the Secretary of Transportation to conduct a study on the establishment of a new major public airports in the United States including (a) identifying potential locations (b) evaluating such locations and (c) investigating alternative methods of financing the land acquisition and development costs necessary for such establishment The report assesses needs for major new airports in the United States through the year 2000 Potential airport locations the general size requirements of new airports financing, and airport development issues and problems are also analyzed under a variety of future conditions The potential need for new major airports is highly sensitive to the future forecasted activity extent of accommodation of general aviation effectiveness of the upgraded third generation air traffic control system in increasing capacity and peak spreading, in that order Author (GRA)

N78-16245# Transportation Systems Center Cambridge, Mass
PRELIMINARY LIMITED SURVEILLANCE RADAR (LSR) COST/BENEFIT ANALYSIS Final Report, Dec 1976 - Apr 1977
Paul S Rempfer Oct 1977 53 p refs
(AD-A046829 TSC-FAA-77-16) Avail NTIS HC A04/MF A01 CSCL 17/9

This report presents the findings of a cost/benefit analysis of the deployment of a new Limited Surveillance Radar (LSR) An LSR is an inexpensive single channel short-range (about

20 miles) primary radar for use at approach control facilities which cannot economically justify an Airport Surveillance Radar/Radar Beacon System (ASR/RBS) An LSR can also be used in tower cabs to aid in VFR operation where a BRITE display is not feasible due to coverage limitations dictated by obstructions or distance from the parent radar facility The study is preliminary in that it is brief and uses rough estimates and assumptions for both benefits and costs Its purpose is to give a gross estimate of the current deployment potential of the LSR and to aid in decisions regarding further system analysis development and testing Author (GRA)

N78-16372# Naval Postgraduate School, Monterey, Calif
A STUDY OF PULL-THROUGH FAILURES OF MECHANICALLY FASTENED JOINTS M S Thesis
Robert N Freedman Sep 1977 81 p refs
(AD-A047142) Avail NTIS HC A05/MF A01 CSCL 13/5

The relationship between the bending moment and the through-plane shear force in the vicinity of a mechanical fastener at failure was determined Experiments were conducted on 4-inch wide flat plate aluminum and graphite-epoxy composite specimens that modeled portions of a wing skin along a spar and along a rib The composite specimens were either 8-ply or 16-ply balanced layups and were simply supported at two opposing edges and free along the other two edges The fasteners were pulled normal to the plates, and the maximum force at failure was measured for specimen lengths varying from two to six inches between supports Two analyses were made, one for small elastic deflections of a thin orthotropic plate and another for a beam in the elastic range A mesh generator for a finite element model of the plate around the fastener was also developed for the computer program ADINA GRA

N78-16376# Army Test and Evaluation Command, Aberdeen Proving Ground, Md
ARRIVAL INSPECTIONS/PRE-OPERATIONAL INSPECTIONS (AVIATION MATERIEL) Final Report
Roy L Miller 31 Aug 1977 22 p refs Supersedes TOP-1-3-505
(AD-A047260, TOP-7-3-503 TOP-1-3-505 Avail NTIS HC A02/MF A01 CSCL 01/3

A method is described for evaluation of test item completeness conditions, and operability upon receipt for testing This report identifies the facilities and equipment required It provides procedures for documents arrival, receiving packaging, maintenance test package, item inventory safety preoperational and technical inspections This is applicable to aviation materiel Author (GRA)

N78-16391# National Aeronautical Establishment Ottawa (Ontario)
THE DISSECTION OF AN AIRCRAFT LOADS SPECTRUM PRODUCED BY PEAK-COUNTING ACCELEROMETERS
A V Rugienius 16 Nov 1977 24 p refs
(LTR-ST-951, ICAF-978) Avail NTIS HC A02/MF A01

Wing fatigue damage to aircraft was examined in regard to measurements made by peak-counting accelerometers Major causes of damage were defined as repetitive stresses caused by ground loads, air loads and the ground-air-ground cycle These phases of the aircraft loads environment were discussed in detail Recommendations were made on the procedure for converting accelerometer data into loads spectra B L P

N78-16392# National Aeronautical Establishment Ottawa (Ontario)
MODIFICATIONS TO FALSTAFF THAT WERE REQUIRED FOR OPERATION ON A 16 K PDP-8e MINICOMPUTER
Rolf Hangartner 15 Feb 1977 19 p refs
(LTR-ST-899, ICAF-977) Avail NTIS HC A02/MF A01

The FALSTAFF (fighter aircraft loading standard for fatigue evaluation) is a computer program that utilizes a Markov chain method to generate a simulation of a service load history for a typical fighter aircraft This service load history consisted of 200 flights of varying length and severity and was characterized by some 36,000 values in a sequence of maximum and minimum loads The sequence of loads was generated from a set of matrices representing the bivariate distributions of load for three characteristic flight missions and from other statistical data concerning flight duration, aircraft configuration, and ground loads by means of a computer program written in FORTRAN This program may be adapted to output the load sequence in a form appropriate to a particular fatigue testing system, i e punched tape, magnetic tape, or direct machine output Author

N78-16741 Texas Univ , Austin
A TANDEM-QUEUE ALGORITHM FOR EVALUATING OVERALL AIRPORT CAPACITY Ph.D Thesis
Chang-Ho Park 1977 190 p
Avail Univ Microfilms Order No 77-23011

Development is given for an analytical model of an airport system that can be used to evaluate overall airport capacity Capacity is defined as the maximum flow-rate that can be imposed on an airport without violating user-specified, level-of-service criteria for airport components A deterministic queueing algorithm is presented The main thrust of the approach is to tie individual component models together to relate the input to one component and the output to one component and the output from preceding components The overall algorithm is intended for estimating component level of service measures These measures are then evaluated by the user of the model Dissert Abstr

N78-16816# Naval Electronics Lab Center San Diego Calif
A-7 ALOFT ECONOMIC ANALYSIS AND EMI-EMP TEST RESULTS
R A Greenwell and G M Holma *In* AGARD Opt Fibres Integrated Optics and Their Mil Appl Oct 1977 13 p refs

Avail NTIS HC A24/MF A01

Cost projections for three performance-equivalent cable alternatives coaxial twisted-shielded pair and fibre optic were developed These cost projections were generated by an approach which utilizes two techniques one which computes very specific costs of research and development (R&D) investment, and operation and support (O&S) for the data transmission links, and the other which computes total weapon systems cost of R&D investments and O&S resulting from the inclusion of the field-operation systems The results clearly indicated definite economic benefits with fiber optics Tests were also performed to determine EMI susceptibility and EMP effects on fiber-optic and wire interconnects for the A-7 navigation and weapon delivery subsystem (NWDS) These tests were performed in the laboratory and on the aircraft Results from the EMI and EMP tests have shown that the A-7 ALOFT fiber-optic subsystem is less susceptible to EMI and greatly reduces electromagnetic induction from an induced transient pulse Author

N78-16849# Standard Telecommunication Labs Ltd , Harlow (England)
AN OPTICAL FIBRE, MULTI-TERMINAL DATA SYSTEM FOR AIRCRAFT
J G Farrington and M Chown *In* AGARD Opt Fibres Integrated Optics and Their Mil Appl Oct 1977 12 p refs Sponsored by Ministry of Defense
Avail NTIS HC A24/MF A01

As a result of a study on the potential of optical fiber multiterminal data systems for avionics a design approach was chosen which is expected to be a suitable basis for a wide range of applications This is a time division multiplexing system, which has features of being highly immune to problems of optical loss and multipath effects in optical highways having redundant paths and of avoiding the need for any master terminal This system approach is tailored to characteristics of optical fibers and should lead to good integrity and ruggedness A breadboard model of a terminal was demonstrated Author

N78-16988 Virginia Polytechnic Inst and State Univ Blacksburg
THE EFFECT OF WHITCOMB WINGLETS AND OTHER WINGTIP MODIFICATIONS ON WAKE VORTICES Ph D Thesis
Henry Frederick Faery 1977 175 p
Avail Univ Microfilms Order No 77-26887

Wind tunnel experiments were conducted on six wingtip configurations to determine their wake vortex characteristics The trailing wingtip vortex was probed by a 1/8 inch diameter five hole yawhead pressure probe The vortex tangential and axial velocity profiles are compared at five and twenty chordlengths downstream The Whitcomb winglet and the upper winglet configuration both produce two distinct vortices of the same rotation The maximum tangential velocity in each vortex is about 64 percent less than that produced by a conventional wingtip configuration The lift and drag characteristics of the wingtip configurations are compared The aerodynamic force effects of the wing on the winglet and the winglet on the wing The downwash distribution on the wing both with and without winglets and the effect of different winglet dihedral angles on the wing downwash pattern are discussed Dissert Abstr

N78-16992 Washington Univ Seattle
UNSTEADY HOVERING WAKE PARAMETERS IDENTIFIED FROM DYNAMIC MODEL TESTS Ph D Thesis
Samuel Tribble Crews 1977 123 p
Avail Univ Microfilms Order No 77-28339

The development of a four bladed model rotor that can be excited with a simple eccentric mechanism in progressing and regressing modes with either harmonic or transient inputs was reported Parameter identification methods were applied to the problem of extracting parameters for linear perturbation models including rotor dynamic inflow effects from the measured blade flapping responses to transient pitch-stirring excitations These perturbation models were then used to predict blade flapping response to other pitch-stirring transient inputs and rotor wake and blade flapping responses to harmonic inputs The viability and utility of using parameter identification methods for extracting the perturbation models from transients are demonstrated through these combined analytical and experimental studies
Dissert Abstr

N78-16994 Georgia Inst of Tech Atlanta
DRAG ON AN OSCILLATING AIRFOIL IN A FLUCTUATING FREE STREAM Ph.D Thesis
Sesi Bhushan Rao Kottapalli 1977 161 p
Avail Univ Microfilms Order No 77-28579

The unsteady skin friction drag of an oscillating airfoil exposed to a fluctuating free stream speed was investigated The introduction of fluctuations in the free stream alters the skin friction drag considerably by causing significant fluctuations in the drag There is a considerable difference between the drag behaviors of an airfoil at constant incidence and one undergoing oscillations about a mean angle of attack both subjected to identical fluctuating free streams For an airfoil undergoing oscillations about a mean angle of attack in a fluctuating free stream the phase (with respect to the free stream) and amplitude of the drag fluctuations are strongly dependent on the phase difference between the free stream fluctuations and airfoil oscillations Depending on the values of the phase difference between free stream fluctuations and airfoil oscillations, reduced frequency and amplitude of free stream fluctuations the drag can either lead or lag the free stream Dissert Abstr

N78-16995 Kansas Univ, Lawrence
AN ANALYTICAL MODEL FOR THE STUDY OF HIGHLY SEPARATED FLOW ON LOW SPEED AIRFOILS Ph D Thesis
Sharad Narayanrao Naik 1977 100 p
Avail Univ Microfilms Order No 77-28897

A computer program was developed to solve the low speed flow around airfoils with highly separated flow The flow model includes all of the major physical features in the separated region Flow visualization tests were made to substantiate to the validity of the model The computation involves the matching of the potential flow, boundary layer and flows in the separated regions Head s entrainment theory was used for boundary layer calculations and Korst's jet mixing analysis was used in the separated regions A free stagnation point aft of the airfoil and a standing vortex in the separated region were modelled and computed The separation location and pressure were found iteratively without a priori specification A GA(W)-1 17% thick airfoil at three angles of attack and two Reynolds numbers was used for the analysis Dissert Abstr

N78-16996 Georgia Inst of Tech, Atlanta
A NUMERICAL STUDY OF INCOMPRESSIBLE VISCOUS FLOW AROUND AIRFOILS Ph D Thesis
Sarangan Sampath 1977 215 p
Avail Univ Microfilms Order No 77-29219

An integro-differential formulation for the numerical solution of the two-dimensional incompressible Navier-Stokes equations is developed and applied to the study of dependent incompressible viscous flow past a 9% thick symmetrical airfoil This formulation utilizes vorticity and stream function as dependent variables in the governing equations and has the capability of confining the computations to the region of non-negligible vorticity thus reducing computer time requirements for the study of external viscous flow problems and enables the exact boundary condition on velocity to be satisfied truly at infinity Based on the integral representation for stream function, a method for the determination of vorticity on the solid surface is also presented With this method the physical process of vorticity generation on the solid surface is correctly simulated and the principle of conservation of total vorticity is satisfied Dissert Abstr

N78-16998*# Boeing Vertol Co, Philadelphia Pa
TWO-DIMENSIONAL WIND TUNNEL TEST OF AN OSCILLATING ROTOR AIRFOIL, VOLUME 2 Final Report
L U Dadone 1977 310 p
(Contract NAS1-13795)
(NASA-CR-2915 D-210-11188-2) Avail NTIS HC A14/MF A01 CSCL 01A
For abstract, see N78-16003

N78-16999*# Boeing Commercial Airplane Co, Seattle, Wash
THE PRACTICAL APPLICATION OF A FINITE DIFFERENCE METHOD FOR ANALYZING TRANSONIC FLOW OVER OSCILLATING AIRFOILS AND WINGS Final Report
Warren H Weatherill James D Sebastian, and E Edwards Ehlers
Feb 1978 88 p refs
(Contract NAS1-14204)
(NASA-CR-2933 D6-44419) Avail NTIS HC A05/MF A01 CSCL 01A

Separating the velocity potential into steady and unsteady parts and linearizing the resulting unsteady equations for small disturbances was performed The steady velocity potential was obtained first from the well known nonlinear equation for steady transonic flow The unsteady velocity potential was then obtained from a linear differential equation in complex form with spatially varying coefficients Since sinusoidal motion is assumed, the unsteady equation is independent of time The results of an investigation into the relaxation-solution-instability problem was discussed Concepts examined include variations in outer boundary conditions, a coordinate transformation so that the boundary condition at infinity may be applied to the outer boundaries of the finite difference region and overlapping subregions The general conclusion was that only a full direct solution in which all unknowns are obtained at the same time will avoid the solution instabilities of relaxation An analysis of the one-dimensional form of the unsteady transonic equation was studied to evaluate errors between exact and finite difference solutions Pressure distributions were presented for a low-aspect-ratio clipped delta wing at Mach number of 0 9 and for a moderate-aspect-ratio rectangular wing at a Mach number of 0 875 Author

N78-17000*# National Aeronautics and Space Administration Ames Research Center Moffett Field Calif

DYNAMIC STALL EXPERIMENTS ON THE NACA 0012 AIRFOIL

Kenneth W McAlister Lawrence W Carr, and William J McCroskey Jan 1978 166 p refs

(NASA-TP-1100, A-7096) Avail NTIS HC A08/MF A01 CSCL 01A

The flow over a NACA 0012 airfoil undergoing large oscillations in pitch was experimentally studied at a Reynolds number of 2 5 million and over a range of frequencies and amplitudes Hot-wire probes and surface-pressure transducers were used to clarify the role of the laminar separation bubble, to delineate the growth and shedding of the stall vortex and to quantify the resultant aerodynamic loads In addition to the pressure distributions and normal force and pitching moment data that have often been obtained in previous investigations, estimates of the unsteady drag force during dynamic stall have been derived from the surface pressure measurements Special characteristics of the pressure response, which are symptomatic of the occurrence and relative severity of moment stall, have also been examined

Author

N78-17002*# Kansas Univ Center for Research, Inc Lawrence Flight Research Lab

MINIMUM INDUCED DRAG CONFIGURATIONS WITH JET INTERACTION

Jenn Louh Pao and C Edward Lan Feb 1978 166 p refs (Grant NsG-1139)

(NASA-CR-155929 CRINC-FRL-281-2) Avail NTIS HC A08/MF A01 CSCL 01A

A theoretical method is presented for determining the optimum camber shape and twist distribution for the minimum induced drag in the wing-alone case without prescribing the span loading shape The same method was applied to find the corresponding minimum induced drag configuration with the upper-surface-blowing jet Lan's quasi-vortex-lattice method and his wing-jet interaction theory were used Comparison of the predicted results with another theoretical method shows good agreement for configurations without the flowing jet More applicable experimental data with blowing jets are needed to establish the accuracy of the theory Author

N78-17003# Lockheed Missiles and Space Co , Palo Alto, Calif

OUTLINE OF AEROELASTIC PHENOMENA

A S Volmir [1978] 10 p Transl into ENGLISH from the book "Obolochki v Potoke Zhidkosti i Gaza Zadachi Aerouprugosti' Moscow, Nauka Press, 1976 p 70-81

Avail NTIS HC A02/MF A01, National Translation Center John Crerar Library Chicago Illinois 60616

Aeroelastic processes were examined in regard to their effect of deformation on aircraft wings empennage fuselage and control organs A classification is provided of aeroelastic phenomena, and the concepts of divergence classical flutter panel flutter, stalling flutter aeolian vibrations galloping, buffeting, shaking, and washing are differentiated Diagrams denoting aeroelasticity, aerothermoelectricity and aeroautoelasticity illustrate factors of aeroelastic strain B L P

N78-17004# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany) Inst fuer Stroemungsmechanik

CONTRIBUTIONS TO STEADY AND UNSTEADY AERODYNAMICS

F W Riegels, ed and O Lawaczeck, ed 10 Aug 1977 282 p refs Partly in ENGLISH and partly in GERMAN, ENGLISH summary

(DLR-FB-77-34) Avail NTIS HC A13/MF A01, DFVLR Cologne DM 107,30

Topics discussed are missile aerodynamics, flow separation on wings and cascades and its control, transonic similarity for real gases in cryogenic wind tunnel models, unsteady forces and pressure distributions, acoustic problems in gas turbine power plants performance of sailing boats, a hybrid wind tunnel concept, water jets emerging in vacuum (Spacelab), and neutron sources for fusion reactor materials tests

N78-17005# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany) Inst fuer Aeroelastik

SIGNIFICANCE OF STRUCTURAL NONLINEARITIES FROM THE STRUCTURAL DYNAMICS AND AEROELASTICITY POINT OF VIEW [DIE BEDEUTUNG STRUKTURELLER NICHTLINEARITAETEN AUS DER SICHT DER STRUKTURDYNAMIK UND AEROELASTIK]

E Breitbach *In its* Contrib to Steady and Unsteady Aerodyn 10 Aug 1977 p 7-19 refs In GERMAN

Avail NTIS HC A13/MF A01, DFVLR Cologne DM 107,30

The effects of structure-dependent nonlinearities on the dynamic behavior of aircraft structures were investigated, and their significance for flutter stability analysis and for solution of general dynamic response problems considered Some measurement and analytical compuation problems resulting from structural nonlinearities, and methods for resolving them, are discussed Physical relations are explained using an example of rudder mechanism nonlinearities in manually controlled aircraft ESA

N78-17006# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany) Inst fuer Aeroelastik

THE STALL PROBLEM [ZU DEM PROBLEM DES STALL]

P Bublitz *In its* Contrib to Steady and Unsteady Aerodyn 10 Aug 1977 p 21-32 refs In GERMAN

Avail NTIS HC A13/MF A01 DFVLR Cologne DM 107,30

An extensive literature study concerning the analysis of the complicated phenomena occurring at aerodynamic stalling is reported The findings of this study show that the potential theory method of analysis indicates the correct tendency, but that the separation phenomenon and the vortex formation at large angles need further exploration using different methods ESA

N78-17007# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany) Inst fuer Aeroelastik

UNSTEADY AERODYNAMIC FORCES ON HARMONICALLY OSCILLATING POINTED CIRCULAR CONICAL SHELLS WITH SMALL APERTURE ANGLE [INSTATIONAERE LUFTKRAEFTE AN HARMONISCH SCHWINGENDEN SPITZEN KREISKEGELSCHALEN MIT KLEINEM OEFFNUNGSWINKEL]

H Foersching and K-L Chao *In its* Contrib to Steady and Unsteady Aerodyn 10 Aug 1977 p 33-48 refs In GERMAN

Avail NTIS HC A13/MF A01 DFVLR Cologne DM 107,30

The analytical relations for the calculations were derived from the slender body theory Numerical calculations were carried out for some typical examples and results compared with those of the piston theory ESA

N78-17008# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany) Inst fuer Aeroelastik

THE INTERFERENCE PROBLEM OF THE OSCILLATING FUSELAGE NEAR GROUND [DAS INTERFERENZPROBLEM DES SCHWINGENDEN RUMPFES IN BODENNAEHE]

W Geissler *In its* Contrib to Steady and Unsteady Aerodyn 10 Aug 1977 p 49-60 refs In GERMAN

Avail NTIS HC A13/MF A01 DFVLR Cologne DM 107,30

A numerical method is described for calculation of the steady and unsteady pressure distributions on an axisymmetric body near ground The method operates according to the singularity method with a continuous surface coverage of harmonically pulsating sources and sinks The ground effect is accounted for by the mirror principle, the distance to ground may be selected freely A stationary angle of attack (measured against the rotation axis) and several oscillation modes can be taken into consideration Results are partly compared with measurements ESA

N78-17012# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Goettingen (West Germany) Inst fuer Stroemungsmechanik

EFFECT OF SEPARATION BUBBLES ON THE LIFT OF WING PROFILES [UEBER DEN EINFLUSS VON ABLOESEBLASEN AUF DEN AUFTRIEB VON TRAGFLUEGELPROFILEN]

K Jacob *In its* Contrib to Steady and Unsteady Aerodyn 10 Aug 1977 p 111-123 refs In GERMAN

Avail NTIS HC A13/MF A01, DFVLR Cologne DM 107 30

The problem of high lift behavior of wing profiles as a function of profile shape and Reynolds number is dealt with The case of the combined occurrence of trailing edge separation and a short laminar turbulent separation bubble was examined, and a method developed for overall flow calculation Empirical criteria and relationships were used for approximative consideration of the bubble Maximum lift calculations carried out for two profiles are in good agreement with measurements ESA

N78-17020# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Goettingen (West Germany) Inst fuer Aeroelastik

UNSTEADY PRESSURE DISTRIBUTION MEASUREMENTS AT TWO TRAPEZOIDAL WINGS WITH UNIT ASPECT RATIO [INSTATIONAERE DRUCKVERTEILUNGSMESSUNGEN AN ZWEI TRAPEZFLUEGELN DER STRECKUNG EINS]

E Schmidt *In its* Contrib to Steady and Unsteady Aerodyn 10 Aug 1977 p 227-242 refs In GERMAN

Avail NTIS HC A13/MF A01, DFVLR Cologne DM 107,30

Systematic unsteady pressure distribution measurements were carried out on two sharp-edged tapered wings with unit aspect ratio and tapering lambda = 1/8 and 1/2 (symmetric-circular profile, reference wing depth 1 m) A harmonic longitudinal low amplitude motion at frequencies from 2 5 to 9 4 Hz was superimposed for angles of attack from 0 to 18 deg The flow velocity was 60 m/sec maximum Some characteristic plots are presented which show considerable angle of attack effects upon the unsteady pressure distribution of slender wings The measurements agree with potential theory panel method calculations for zero angle of attack ESA

N78-17025# Grumman Aerospace Corp Bethpage N Y Research Dept

INVESTIGATION OF VTOL UPWASH FLOWS FORMED BY TWO IMPINGING JETS

Richard C Jenkins and William G Hill Jr Nov 1977 87 p refs

(AD-A047805 RE-548) Avail NTIS HC A05/MF A01 CSCL 20/4

This report presents results of an experimental investigation of the complex flows that occur under a VTOL vehicle operating near the ground The effects of geometric and operating parameters on the upwash flow produced by ground impingement of two parallel subsonic jets have been modeled This flow has been subdivided into separate modular elements jet impingement wall jet behavior, stagnation line formation and upwash flow field properties Models have been developed and evaluated for each of these elements These models can be used in numerical computation methods that have been developed to predict such ground effects as suckdown and upwash lift on VTOL aircraft Parameters included in this investigation were jet velocity, distance from the ground separation distance between jets, relative jet strength impingement angle and nozzle diameter Properties of the upwash were determined by local flow measurements above the ground and by ground plane measurements of surface pressure and oil flow patterns GRA

N78-17026# ARO Inc Arnold Air Force Station Tenn

EFFECTS OF ACOUSTIC AND VORTICAL DISTURBANCES ON THE TURBULENT BOUNDARY LAYER AT FREE-STREAM MACH NUMBER 0 5 Final Report, 1 Jul 1974 30 Jun 1976

Dec 1977 100 p refs

(AD-A047921 AEDC-TR-77-73) Avail NTIS HC A05/MF A01 CSCL 20/4

An experimental investigation of the effects of free-stream disturbances on the development of a turbulent boundary layer is described The data obtained at a free-stream Mach number of 0 5 indicated (1) compared to the baseline acoustic disturbances of 133 db acoustic disturbances of up to 150 db did not significantly alter the turbulent boundary-layer skin friction, displacement thickness or momentum thickness and (2) compared to the baseline vortical disturbances of 0 5 percent of the free-stream velocity vortical disturbances of one percent of the free-stream velocity considerably altered the boundary-layer skin friction displacement thickness and momentum thickness as well as their growth rates Author (GRA)

N78-17028# Nielsen Engineering and Research Inc Mountain View Calif

FURTHER STUDIES OF AERODYNAMIC LOADS AT SPIN ENTRY Annual Report, 1 May 1976 - 1 May 1977

Selden B Spangler and Michael R Mendenhall 30 Jun 1977 161 p refs

(Contract N00014-74-C-0344, NR Proj 212-225 RF41411801)

(AD-A047952 NEAR-TR-141 ONR-CR212-225-3 AR-3) Avail NTIS HC A08/MF A01 CSCL 20/4

As part of a continuing investigation of the aerodynamic loads on a fighter-bomber aircraft at spin departure, a coordinated analytical and experimental program was undertaken on vortex shedding from noncircular nose shapes The asymmetric loads induced by nose vortex shedding at zero and nonzero sideslip are a primary cause for adverse handling qualities at high angles of attack A theoretical analysis for vortex shedding from noncircular nose shapes at combined angles of attack and sideslip was developed Boundary layer separation is predicted in order to determine the rate of shedding of vorticity Comparisons with separation data on two dimensional cylinders and with measured loads and flow field velocities in the wake for inclined ogive-cylinders give reasonable agreement Tests were conducted in the V/STOL tunnel at NASA Langley Research Center and the Nielsen Engineering - Research water tunnel on a fighter model and typical fighter nose shapes GRA

N78-17029# European Space Agency Paris (France)

A NUMERICAL METHOD FOR CALCULATING THE UNSTEADY AERODYNAMIC PRESSURE DISTRIBUTION ON HARMONICALLY OSCILLATING WINGS WITH CONTROL SURFACES IN SUBSONIC FLOW THEORY AND RESULTS FOR COMPRESSIBLE FLOW, PART 2

Wolfgang Geissler Nov 1977 52 p refs Transl into ENGLISH of 'Ein numerisches Verfahren zur Berechnung der instationaeren aerodyn Druckverteilung der harmonisch schwingenden Tragflaeche mit Ruder in Unterschallstroemung Theorie u Ergeb fuer kompressible Stroemung, Teil 2 DFVLR Goettingen West Ger Report DLR-FB-77-15 22 Apr 1977 Original report in GERMAN previously announced as N78-14015 Original German report available from DFVLR Cologne DM 25 90

(ESA-TT-430 DLR-FB-77-15) Avail NTIS HC A04/MF A01

A numerical method to calculate the unsteady pressure and force distributions on harmonically oscillating three-dimensional wings with control surfaces in subsonic flow is presented This panel-method is based on the velocity potential and has the advantage that local unsteady lift and moment coefficients necessary for flutter investigations can be determined in a simple and sufficient way The numerical method for compressible flow is described in detail and numerous results and comparisons with other methods and with experimental data are presented Author (ESA)

N78-17034# Electromagnetic Compatibility Analysis Center, Annapolis Md

AUTOMATED UHF FREQUENCY ASSIGNMENT SYSTEM FOR FAA AIR TRAFFIC CONTROL COMMUNICATIONS Final Report

Thomas Hensler and John Morrow Jun 1977 94 p Prepared in cooperation with IIT Research Inst Annapolis
(Contract DOT-FA70WAI-175)
(AD-A047847, FAA-RD-77-96 ECAC-PR-77-012) Avail NTIS HC A05/MF A01 CSCL 17/7

An automated UHF Frequency Assignment System (UHF-FAS) was developed as a means of providing frequency assignment plans for FAA Air Traffic Control (ATC) UHF communications facilities The UHF-FAS consists of a series of computer programs and can be used to investigate the advantages of different frequency assignment strategies (including partial and complete assignments), detect assignments that do not meet the FAA criterion provide statistical analyses, and plot ATC service volumes Author

N78-17035# Lincoln Lab, Mass Inst of Tech, Lexington
PROPOSED TECHNICAL CHARACTERISTICS FOR THE DISCRETE ADDRESS BEACON SYSTEM (DABS)
J D Welch and P H Robeck 30 Sep 1977 63 p
(Contracts DOT-FA72WAI-261 F19628-76-C-0002, FAA Proj 034-241-012)
(AD-A048246 ATC-71 FAA-RD-77-143) Avail NTIS HC A04/MF A01 CSCL 17/7

A detailed performance specification for the DABS transponder is provided including specifications on transponder receiver sensitivity and performance in interference Specifications for a proposed digital datalink interface are included and message and control fields associated with experimental transponder data applications are defined Guidance material on the performance of an optional transponder antenna diversity scheme is presented Author

N78-17036# Lincoln Lab, Mass Inst of Tech Lexington
DEVELOPMENT OF A DISCRETE ADDRESS BEACON SYSTEM Quarterly Technical Summary, 1 Jul - 30 Sep 1977
1 Oct 1977 23 p
(Contracts DOT-FA72WAI-261 F19628-76-C-0002, FAA Proj 034-241-012)
(AD-A048247, FAA-RD-77-159 QTS-23) Avail NTIS HC A02/MF A01 CSCL 17/7

Analytical studies, laboratory and flight experiments, and software developments supporting the concept feasibility and performance definition phase of the FAA DABS Program are described Topics considered include antenna pattern measurements on the first of two candidate L-band monopulse antennas (modified hogtrough) design effort on the Calibration and Performance Monitor Equipment slated for prototype sensor evaluation and the initial stage of validating the performance of Aircraft Reply and Interference Environment Simulator as interfaced with the DABS sensor at DABSEF J M S

N78-17037*# Research Triangle Inst Research Triangle Park N C
INVESTIGATION OF NEW TECHNIQUES FOR AIRCRAFT NAVIGATION USING THE OMEGA NAVIGATION
Ernest G Baxa Jr Feb 1978 238 p refs
(Contract NAS1-14005)
(NASA-CR-145303 RTI-4378-1152-F) Avail NTIS HC A11/MF A01 CSCL 17G

An OMEGA navigation receiver with a microprocessor as the computational component was investigated A version of the INTEL 4004 microprocessor macroassembler suitable for use on the CDC-6600 system and development of a FORTRAN IV simulator program for the microprocessor was developed Supporting studies included development and evaluation of navigation algorithms to generate relative position information from OMEGA VLF phase measurements Simulation studies were used to evaluate assumptions made in developing a navigation equation in OMEGA Line of Position (LOP) coordinates Included in the navigation algorithms was a procedure for calculating a position in latitude/longitude given an OMEGA LOP fix Implementation of a digital phase locked loop (DPLL) was evaluated on the basic of phase response characteristics over a range of input phase variations Included also is an analytical evaluation on the basis of error probability of an algorithm for automatic time synchronization of the receiver to the OMEGA broadcast format The use of actual OMEGA phase data and published propagation prediction corrections to determine phase velocity estimates was discussed Author

N78-17041*# National Aeronautics and Space Administration Lewis Research Center, Cleveland Ohio
PRELIMINARY STUDY OF PROPULSION SYSTEMS AND AIRPLANE WING PARAMETERS FOR A US NAVY SUBSONIC V/STOL AIRCRAFT
C L Zola L H Fishbach, and J L Allen Feb 1978 42 p refs
(NASA-TM-73652, E-9519) Avail NTIS HC A03/MF A01 CSCL 01C

Two V/STOL propulsion concepts were evaluated in a common aircraft configuration One propulsion system consists of cross coupled turboshaft engines driving variable pitch fans The other system is a gas coupled combination of turbojet gas generators and tip turbine fixed pitch fans Evaluations were made of endurance at low altitude low speed loiter with equal takeoff fuel loads Effects of propulsion system sizing bypass ratio and aircraft wing planform parameters were investigated and compared Shaft driven propulsion systems appear to result in better overall performance although at higher installed weight than gas systems Author

N78-17042*# National Aeronautics and Space Administration Washington D C
AEROSPATIALE IS READY TO DEVELOP A CONVERTIPLANE WITH TETHERING ROTORS
Jacques Morisset Aug 1977 11 p Transl into ENGLISH from Air et Cosmos (France) no 662 12 Mar 1977 p 19-22 Translation was announced as A77-26913 Transl by Transemantics Inc Washington D C
(Contract NASw-2792)
(NASA-TM-75038) Avail NTIS HC A02/MF A01 CSCL 01C

Information on the recent study of the convertiplane is reported The convertiplane was designed to replace the conventional helicopter Its speed is much faster than that of the helicopter, it uses less fuel, and can carry up to five passengers The discovery of the convertiplane was brought about because the helicopter is handicapped by its slow speed and can carry only a few passengers Author

N78-17043# Lockheed Missiles and Space Co Palo Alto Calif
SUPERELEMENT METHOD OF DESIGNING A HELICOPTER FUSELAGE
O M Aksenov and Z I Burman [1978] 6 p refs Transl into ENGLISH from Izv Vyssh Ucheb Zaved Aviats Tekh (USSR) no 2, 1977 p 12-17
Avail NTIS HC A02/MF A01, National Translation Center John Crerar Library, Chicago, Illinois 60616

A method of helicopter fuselage design based on separated fuselage substructures known as superelements is developed for full-scale fuselages The theory and general algorithm utilizing the method of forces are presented B L P

N78-17044# McDonnell Aircraft Co St Louis, Mo
STRESS HISTORY SIMULATION VOLUME 2 A USERS MANUAL FOR A COMPUTER PROGRAM TO MODIFY STRESS HISTORY SIMULATIONS Final Report, May 1975 - Jul 1976
H T Young F R Foster, and H D Dill Mar 1977 133 p refs
(Contract F33615-75-C-3112)
(AD-A042785 AFFDL-TR-76-113-Vol-2) Avail NTIS HC A07/MF A01 CSCL 01/3

This report presents a description of a computer program to combine and modify stress history simulations generated by a companion computer program described in Volume I Input random stress history data sets are combined and modified to create stress spectra variations Each variation is characterized by its mission mix a mission mix consists of a particular order of

mission types (Air-to-Air Air-to-Ground and Instrumentation and Navigation) An example problem is included which demonstrates the program output a sequential list of peaks and valleys of the flight by flight spectrum and a summary table of the coupling of the peaks and valleys Both of the computer programs were used in a study of load sequence effects on crack growth summarized in AFFDL-TR-76-112 Effects of Fighter Attack Spectrum on Crack Growth Author (GRA)

N78-17045# Naval Air Development Center Warminster Pa Aircraft and Crew Systems Technology Directorate
STATISTICAL REVIEW OF COUNTING ACCELEROMETER DATA FOR NAVY AND MARINE FLEET AIRCRAFT FROM 1 JANUARY 1962 TO 30 JUNE 1977 Semiannual Summary Report
Alan M Kaniss 1 Nov 1977 157 p Supersedes report dated 1 May 1977
(AD-A047857) Avail NTIS HC A08/MF A01
CSCL 01/4

This report is a specialized summary of normal acceleration data recorded by counting accelerometers Data are separated by calendar time and mission category Only data reported in the counting accelerometer program are included Author (GRA)

N78-17046# Army Aeromedical Research Lab Fort Rucker Ala
TOXICOLOGIC GAS EVALUATION OF THE UTILITY TACTICAL TRANSPORT AIRCRAFT SYSTEM (UH-60) Final Report
Richard L Schumaker and Gary D Pollard Jul 1977 13 p refs
(AD-A047801 USAARL-77 18) Avail NTIS HC A02/MF A01 CSCL 01/3

The accumulation of toxic gases in US Army combat and combat support aircraft presents a significant hazard for the aircrew in addition to the combat forces and aeromedical evacuation patients being transported The US Army Aeromedical Research Laboratory is conducting an on-going evaluation of the cockpit and cabin environment of current and future helicopter and fixed wing aircraft Toxic product accumulation evaluation during actual flight with weapons firing presents a difficult technicologic challenge This study of toxic gases due to aircraft engine operation and weapons firing demonstrates adequate ventilation for the compounds carbon monoxide nitrogen dioxide, nitric oxide, sulfur dioxide and hydrogen cyanide Single samples of hydrogen sulfide demonstrate instantaneous toxic levels Biochemical and analytical techniques are being refined to further evaluate on-line in-flight hydrogen sulfide levels in US Army aircraft under actual combat conditions Author (GRA)

N78-17047# Air Force Inst of Tech Wright-Patterson AFB Ohio School of Engineering
A DISCRETE-EVENT DIGITAL SIMULATION MODEL OF THE F-16 FIRE CONTROL COMPUTER OPERATIONAL FLIGHT PROGRAM USING SIMSCRIPT 2 5 M.S Thesis
L R Hanson Dec 1977 108 p refs
(AD-A048164 AFIT/GE/MA/77-1) Avail NTIS HC A06/MF A01 CSCL 09/2

In support of a request from the Air Force Avionics Laboratory a model of the F-16 Fire Control Computer (FCC) Operational Flight Program (OFP) was developed The initial specification required that this model allow for possible changes to the rate of accomplishment of various OFP mode-dependent tasks The reconfiguration of the input and output tasks and the processing reserve were of particular interest In order to determine the most useful approach, the various computer system modeling relationships are first reviewed Based on the author s background *the real world system and the modeling goals a discrete event* queue level simulation using SIMSCRIPT 2 5 is selected as the desired approach The basic features of the F-16 FCC and the OFP are discussed and a description of the task movement in the system is provided This description is used to detail the various rate groups and their member tasks The model is verified by comparison against data derived from an actual system run and a statistical analysis provided by the OFP manufacturer The verification process showed that all the original design objectives were met, although several areas of possible improvement to the model are indicated and discussed Author (GRA)

N78-17048# Advisory Group for Aerospace Research and Development, Paris (France)
APPLICATIONS OF STRUCTURAL OPTIMIZATION FOR STRENGTH AND AEROELASTIC DESIGN REQUIREMENTS
Warner Lansing (Grumman Aerospace Corp Bethpage N Y) Edwin Lerner and Ronald F Taylor (AFFDL) Jan 1978 25 p refs Presented at the 45th Struct and Mater Panel Meeting, Voss Norway Sep 1977
(AGARD-R-664 ISBN-92-835-1269-3) Avail NTIS HC A02/MF A01

The need to design airframe components of minimum weight while taking into account both strength and aeroelastic requirements has been recognized for some time An historical review is presented of optimization technology development and a state of the art survey of methods in use by the U S industry that indicate considerable progress was made in automating this aspect of the airframe design process It is concluded that algorithms for addressing strength and flutter are now sufficiently developed for practical use at all levels of design and for addressing other aeroelastic design objectives in the preliminary design stage It is recommended that airframe designers utilize these methods more extensively in future aircraft development programs Additional effort is needed to extend some of the finite element resizing techniques so that static aeroelastic design objectives can be treated as effectively as flutter-speed requirements and additional computer software development is always desirable to upgrade analysis and data management capabilities Author

N78-17049# Advisory Group for Aerospace Research and Development Paris (France)
TECHNICAL EVALUATION REPORT ON THE FLIGHT MECHANICS PANEL SYMPOSIUM ON ROTORCRAFT DESIGN
H R Velkoff (Ohio State Univ Columbus) Jan 1978 14 p refs Symp held at NASA Ames Research Center Moffett Field Calif 16-19 May 1977
(AGARD-AR-114 ISBN-92-835-1273-1) Avail NTIS HC A02/MF A01

The status of rotorcraft design and development the possible divergence of the development pattern of military and civil helicopters and the possibilites for greater coordination in the development of future rotary wing aircraft are considered Specific topics discussed include (1) military requirements and new military rotorcraft (2) civil operations and new civil helicopters (3) rotary wing aircraft research vehicles (4) wind tunnel and flight research (5) common ground for military and civil cooperation in the development of rotary wing aircraft and (6) coordination of military and civil requirements and specifications It is recommended to seek out ways to maximize common mission and design features to reduce overlapping costs and increase production . J M S

N78-17050*# Santa Clara Univ Calif Dept of Electrical Engineering and Computer Science
AIRCRAFT ATTITUDE MEASUREMENT USING A VECTOR MAGNETOMETER
R Peitila and W R Dunn Jr 1 Dec 1977 170 p refs
(Grant NGR-05-017-031)
(NASA-CR-155565) Avail NTIS HC A08/MF A01 CSCL 01D

The feasibility of a vector magnetometer system was investigated by developing a technique to determine attitude given magnetic field components Sample calculations are then made using the earth s magnetic field data acquired during actual flight conditions Results of these calculations are compared graphically with measured attitude data acquired simultaneously with the magnetic data The role and possible implementation of various reference angles are discussed along with other pertinent considerations Finally it is concluded that the earth s magnetic field as measured by modern vector magnetometers can play a significant role in attitude control systems Author

N78-17051*# Santa Clara Univ Calif Dept of Electrical Engineering and Computer Science
EVALUATION OF STOL NAVIGATION AVIONICS Final Technical Report
W R Dunn Jr 1 Dec 1977 276 p refs
(Grant NGR-05-017-031)
(NASA-CR-155566) Avail NTIS HC A13/MF A01 CSCL 01D

Research projects including work on a vector magnetometer for aircraft attitude measurement are summarized The earth s electric field phenomena was investigated in its application to aircraft control and navigation Research on electronic aircraft cabin noise suppression is reviewed and strapdown inertial reference unit technical support is outlined B L P

N78-17053*# National Aeronautics and Space Administration, Washington D C
EXPERIMENTAL TESTING OF FLIGHT CONTROL HEAD UP DISPLAYS
M Berjal Jan 1978 15 p Transl into ENGLISH of Experimentation de Dispositifs de Pilotage Tete Haute" Rept Vol 2 Editions Chiron Electron and Civil Aviation Intern Conf (Paris) 1972 p 1033-1046 Translation was announced as A73-32508 Transl by Kanner (Leo) Associates, Redwood City, Calif
(Contract NASw-2790)
(NASA-TM-75205) Avail NTIS HC A02/MF A01 CSCL 01D

Experiments and tests with 4 generations of head up displays was reported The CV 191, based on fighter aircraft gunsights was replaced by the CV 193 with several improvements The CV 193 V incorporates the velocity vector reference mark eliminates much other data clusters the rest in a small area of the visual field and is seen together with the outside landscape The CV 91 presents only velocity vector and total angle of descent data, used when runway and horizon are visible TC 121 displays an outline of the runway and can be used in visual and instrument approaches Author

N78-17054 Tennessee Univ , Knoxville
AN ANALYSIS OF THE INFLUENCE OF SOME EXTERNAL DISTURBANCES ON THE AERODYNAMIC STABILITY OF TURBINE ENGINE AXIAL FLOW FANS AND COMPRESSORS Ph D Thesis
William F Kimzey 1977 287 p
Avail Univ Microfilms Order No 77-27675

The development of a one-dimensional, time-dependent mathematical compressor model for analysis of planar disturbances and an extension of the model to a three-dimensional form for analysis of distortion was accomplished Compressor stage force and shaft work were determined from empirical stage characteristics with corrections made for unsteady cascade airfoil aerodynamics Example problems solved using the one-dimensional analysis include determination of the steady-state state stability limit with undisturbed flow instability caused by oscillating planar inflow and dynamic response of a compressor to oscillating entry pressure Example problems solved using the distortion model include stability limit line reduction caused by a combined radial and circumferential pressure distortion and pure pressure and temperature circumferential distortion effects Dissert Abstr

N78-17055* National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
VARIABLE THRUST NOZZLE FOR QUIET TURBOFAN ENGINE AND METHOD OF OPERATING SAME Patent
Arthur P Adamson inventor (to NASA) (GE Cincinnati Ohio) Issued 17 Jan 1978 7 p Filed 29 May 1975 Sponsored by NASA
(NASA-Case-LEW-12317-1 US-Patent-4 068,469, US-Patent-Appl-SN-581750 US-Patent-Class-60-204 US-Patent-Class-60-226R, US-Patent-Class-60-271) Avail US Patent Office CSCL 21E

An improved method of operating a gas turbine engine is presented wherein engine-generated noise is maintained at a reduced level during reduced thrust operation Fan speed was maintained at a constant level while fan nozzle area was increased This maintained high inlet Mach numbers for reduced forward noise propagation and also permited reduced nozzle exhaust velocity for reduced shear noise In another embodiment, airflow was increased by means of a fan blade pitch change or speed increase while the fan nozzle area was increased yielding both a net reduction in engine thrust and noise
Official Gazette of the U S Patent Office

N78-17057*# National Aeronautics and Space Administration *Langley Research Center, Langley Station, Va*
INTERNAL PERFORMANCE PREDICTIONS FOR LANGLEY SCRAMJET ENGINE MODULE
S Z Pinckney Jan 1978 81 p refs
(NASA-TM-X-74038) Avail NTIS HC A05/MF A01 CSCL 21E

A one dimensional theoretical method for the prediction of the internal performance of a scramjet engine is presented The effects of changes in vehicle forebody flow parameters and characteristics on predicted thrust for the scramjet engine were evaluated using this method and results are presented A theoretical evaluation of the effects of changes in the scramjet engine s internal parameters is also presented Theoretical internal performance predictions in terms of thrust coefficient and specific impulse are provided for the scramjet engine for free stream Mach numbers of 5 6 and 7 free stream dynamic pressure of 23,940 N/sq m forebody surface angles of 4 6 deg to 14 6 deg and fuel equivalence ratio of 1 0 Author

N78-17058*# Pratt and Whitney Aircraft West Palm Beach Fla Government Products Div
ANALYTICAL STUDY OF THERMAL BARRIER COATED FIRST-STAGE BLADES IN AN F100 ENGINE Progress Report, 1 Sep 1977 - 31 Jan 1978
D E Andress Feb 1978 27 p
(Contract NAS3-21032)
(NASA-CR-135359 FR-9609) Avail NTIS HC A03/MF A01 CSCL 21E

Heat transfer and stress analyses were performed on two sections of a thermal barrier coated (TBC) F100 1st-stage turbine blade Results of the analyses indicate that the TBC on the leading edges of both sections experience the highest elastic strain ranges and these occur during transient engine operation Further study is recommended to determine the effects of plastic deformation (creep) and creep-fatigue interaction on coating life Author

N78-17059*# National Aeronautics and Space Administration Lewis Research Center, Cleveland Ohio
CERAMICS IN GAS TURBINE POWDER AND PROCESS CHARACTERIZATION
Sunil Dutta 1977 16 p refs Presented at the Conf on Composites and Advanced Maters Cocoa Beach Fla 17-19 Jan 1977, Sponsored by Am Ceramic Soc
(NASA-TM-73875 E-9475) Avail NTIS HC A02/MF A01 CSCL 21E

Some of the intrinsic properties of various forms of Si3N4 and SiC are listed and limitations of such materials availability are pointed out The essential features/parameters to characterize a batch of powder are discussed including the standard techniques for such characterization In process characterization parameters in sintering reaction sintering and hot pressing processes are discussed including the factors responsible for strength limitations in ceramic bodies Significant improvements in material properties can be achieved by reducing or eliminating the strength limiting factors with consistent powder and process characterization along with process control Author

N78-17060*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
GENERAL AVIATION ENERGY-CONSERVATION RESEARCH PROGRAMS AT NASA-LEWIS RESEARCH CENTER
Edward A Willis 1977 26 p refs Presented at the Conf on Energy Conserv in Gen Aviation Kalamazoo Mich 10 - 11 Oct 1977 sponsored by Western Michigan Univ
(NASA-TM-73884) Avail NTIS HC A03/MF A01 CSCL 21E

The major thrust of NASA s nonturbine general aviation engine programs is directed toward (1) reduced specific fuel consumption (2) improved fuel tolerance and (3) emission reduction Current

and planned future programs in such areas as lean operation, improved fuel management advanced cooling techniques and advanced engine concepts are described These are expected to lay the technology base by the mid to latter 1980 s, for engines whose total fuel costs are as much as 30% lower than today's conventional engines Author

N78-17061*# Raman Aeronautics Research and Engineering, Inc Palo Alto Calif

AN ANALYSIS OF THE ROTOR BLADE STRESSES OF THE THREE STAGE COMPRESSOR OF THE AMES RESEARCH CENTER 11- BY 11-FOOT TRANSONIC WIND TUNNEL Final Report

Jules B Dods Jr Nov 1977 147 p refs
(Contract NAS2-9112)
(NASA-CR-152083) Avail NTIS HC A07/MF A01 CSCL 21E

The static and dynamic rotor blade stresses of the three stage compressor were measured Data are presented in terms of total blade stress for the complete operational range of compressor speeds and tunnel total pressures Modal frequencies and variations with tunnel conditions were measured Phase angles and coherences between various gage combinations are also presented Recommendations for improvements are given for future rotor blade experimental investigations Author

N78-17062*# Boeing Co Seattle Wash

LOW SPEED TEST OF A HIGH-BYPASS-RATIO PROPULSION SYSTEM WITH AN ASYMMETRIC INLET DESIGNED FOR A TILT-NACELLE V/STOL AIRPLANE

J Syberg Jan 1978 115 p refs
(Contract NAS2-9640)
(NASA-CR-152072 D-180-22888-1) Avail NTIS HC A06/MF A01 CSCL 21E

A large scale model of a lift/cruise fan inlet designed for a tilt nacelle V/STOL airplane was tested with a high bypass ratio turbofan Testing was conducted at low freestream velocities with inlet angles of attack ranging from 0 deg to 120 deg The operating limits for the nacelle were found to be related to inlet boundary layer separation Small separations originating in the inlet diffuser cause little or no performance degradation However, at sufficiently severe freestream conditions the separation changes abruptly to a lip separation This change is associated with a significant reduction in nacelle net thrust as well as a sharp increase in fan blade vibratory stresses Consequently the onset of lip separation is regarded as the nacelle operating limit The test verified that the asymmetric inlet design will provide high performance and stable operation at the design forward speed and angle of attack conditions At some of these however, operation near the lower end of the design inlet airflow range is not feasible due to the occurrence of lip separation Author

N78-17063*# Cincinnati Univ Ohio Dept of Aerospace Engineering

OPTIMIZATION STUDY FOR HIGH SPEED RADIAL TURBINE WITH SPECIAL REFERENCE TO DESIGN VARIABLES

I Khalil and W Tabakoff Oct 1977 67 p refs Prepared in cooperation with Army Air Mobility Research and Development Lab Moffett Field Calif
(Contract NAS2-7850)
(NASA-CR-152094) Avail NTIS HC A04/MF A01 CSCL 21E

Numerical results of a theoretical investigation are presented to provide information about the effect of variation of the different design and operating parameters on radial inflow turbine performance The effects of variations in the mass flow rate rotor tip Mach number inlet flow angles number of rotor blades and hub to shroud radius ratio on the internal fluid dynamics of turbine rotors, were investigated A procedure to estimate the flow deviation angles at the turbine exit is also presented and used to examine the influence of the operating conditions and the rotor geometrical configuration on these deviations The significance of the results obtained is discussed with respect to improved turbine performance Author

N78-17064*# Pratt and Whitney Aircraft Group East Hartford Conn Commercial Products Div

METHOD OF FAN SOUND MODE STRUCTURE DETERMINATION Final Report

G F Pickett, T G Sofrin and R W Wells Aug 1977 160 p refs
(Contract NAS3-20047)
(NASA-CR-135293 PWA-5554-3) Avail NTIS HC A08/MF A01 CSCL 21E

A method for the determination of fan sound mode structure in the inlet of turbofan engines using in-duct acoustic pressure measurements is presented The method is based on the simultaneous solution of a set of equations whose unknowns are modal amplitude and phase A computer program for the solution of the equation set was developed An additional computer program was developed which calculates microphone locations the use of which results in an equation set that does not give rise to numerical instabilities In addition to the development of a method for determination of coherent modal structure experimental and analytical approaches are developed for the determination of the amplitude frequency spectrum of randomly generated sound models for use in narrow annulus ducts Two approaches are defined one based on the use of cross-spectral techniques and the other based on the use of an array of microphones Author

N78-17065*# Pratt and Whitney Aircraft Group East Hartford Conn Commercial Products Div

METHOD OF FAN SOUND MODE STRUCTURE DETERMINATION COMPUTER PROGRAM USER'S MANUAL MICROPHONE LOCATION PROGRAM

G F Pickett, R A Wells and R A Love Aug 1977 72 p refs
(Contract NAS3-20047)
(NASA-CR-135294, PWA-5554-4) Avail NTIS HC A04/MF A01 CSCL 21E

A computer user s manual describing the operation and the essential features of the microphone location program is presented The Microphone Location Program determines microphone locations that ensure accurate and stable results from the equation system used to calculate modal structures As part of the computational procedure for the Microphone Location Program, a first-order measure of the stability of the equation system was indicated by a matrix conditioning number Author

N78-17066*# Pratt and Whitney Aircraft Group East Hartford Conn Commercial Products Div

METHOD OF FAN SOUND MODE STRUCTURE DETERMINATION COMPUTER PROGRAM USER'S MANUAL MODAL CALCULATION PROGRAM

G F Pickett R A Wells and R A Love Aug 1977 74 p refs
(Contract NAS3-20047)
(NASA-CR-135295 PWA-5554-5) Avail NTIS HC A04/MF A01 CSCL 21E

A computer user s manual describing the operation and the essential features of the Modal Calculation Program is presented The modal Calculation Program calculates the amplitude and phase of modal structures by means of acoustic pressure measurements obtained from microphones placed at selected locations within the fan inlet duct In addition the Modal Calculation Program also calculates the first-order errors in the modal coefficients that are due to tolerances in microphone location coordinates and inaccuracies in the acoustic pressure measurements Author

N78-17067# Air Force Inst of Tech Wright-Patterson AFB Ohio School of Systems and Logistics

DEVELOPMENT OF COST ESTIMATING RELATIONSHIPS FOR AIRCRAFT JET CORE-ENGINE OVERHAUL COSTS M S Thesis

Robert A Breglio Jr Sep 1977 160 p refs
(AD-A047667, AFIT-LSSR-31-77B) Avail NTIS HC A08/MF A01 CSCL 21/5

Cost estimation is a wide open area within the Department of Defense and accurate cost estimating models are a valuable

tool in the life cycle costing of a weapon system This research effort utilized multiple linear regression analysis to develop parametric cost models or cost estimating relationships (CERs) for jet engine depot overhaul costs Both engine operating parameters e g turbine inlet temperature, RPM, etc , and engine physical characteristics, e g , length, weight etc were considered as probable cost drivers Extensive analysis was performed to determine the reliability of the data base The major finding of this study was that models can be developed with acceptable explanatory power with respect to variation in the data base, using data of questionable reliability Thus a model developed should not be accepted on the basis of explanatory power alone but should be tested further to determine its utility as a cost estimator Author (GRA)

N78-17068# ARO, Inc , Arnold Air Force Station, Tenn
OPTICAL MEASUREMENTS OF NO AND NO SUB 2 IN THE EXHAUST OF AN F101-GE-100 ENGINE AT SIMULATED ALTITUDES Final Report, 12 Jan 1975 - 1 Apr 1977
J D Few AEDC Dec 1977 26 p refs
(AD-A047882 ARO-ETF-TR-77-42 AEDC-TR-77-75) Avail NTIS HC A03/MF A01 CSCL 21/2

Measurements of nitric oxide (NO) and nitrogen dioxide (NO2) concentrations were made in the exhaust of an F101-GE-100 engine using ultraviolet (UV) spectral absorption techniques The measurements were made at a station 10 2 cm downstream of the engine nozzle exit The NO measurements were made at two engine power settings, intermediate and maximum afterburning the NO2 measurement was made only at intermediate power The line-of-sight absorption measurements through the axisymmetric exhaust stream were converted to local values of concentration via an iterative radial inversion computation These in situ measurements are compared to NO sub x concentration values obtained by conventional probe sampling techniques using a chemiluminescent analyzer Author (GRA)

N78-17069# Avco Lycoming Div , Stratford Conn
ADVANCED SCAVENGE SYSTEMS FOR AN INTEGRATED ENGINE INLET PARTICLE SEPARATOR Final Report, 21 Mar 1975 - 21 Mar 1977
Michael J Zoccoli Sep 1977 200 p refs
(Contract DAAJ02-75-C-0026)
(AD-A047872 LYC-77-26, USAAMRDL-TR-77-26) Avail NTIS HC A09/MF A01 CSCL 21/5

In designing a device which scavenges the gas turbine engine integral particle separator, the fundamental problem is one of providing primarily a durable design that is practical in other important aspects which include, but is not limited to power consumption cost physical size and noise An advanced scavenge system for an integrated engine inlet protection system was developed to demonstrate a 50-hour operational capability at a specified minimum performance level in the severe erosion environment typical of conditions at the exit from the engine particle separator Several alternative configurations were studied, two were selected for detailed design and experimental evaluation GRA

N78-17070*# National Aeronautics and Space Administration Langley Research Center Langley Station Va
FILTERING TECHNIQUE BASED ON HIGH-FREQUENCY PLANT MODELING FOR HIGH-GAIN CONTROL Patent Application
Frank R Niesson and John F Garren Jr inventors (to NASA) Filed 8 Dec 1977 14 p
(NASA-Case-LAR-12215-1, US-Patent-Appl-SN-858762) Avail NTIS HC A02/MF A01 CSCL 01C

An aircraft control system which utilized feedback motion sensors to generate a control signal to control the aircraft is illustrated The use of a complementary filter permitted a substantial increase in frequency bandwidth due to the simultaneous reduction in noise amplification and control limit cycle tendencies NASA

N78-17071# Royal Aircraft Establishment, Farnborough (England)
INFLUENCE OF GUST MODELLING ON THE IDENTIFICATION OF THE DERIVATIVES OF THE LONGITUDINAL MOTION OF AN AIRCRAFT
Gerd Schulz Oct 1977 34 p refs Transl into ENGLISH from report DLR-FB 76-63 (West Germany), 1976, DFVLR, Oberpfaffenhofen 34 p
(RAE-Lib-Trans-1944, BR61071) Avail NTIS HC A03/MF A01

The influence of stochastic modelling of horizontal and vertical gusts on the maximum likelihood identification of derivatives of the longitudinal motion of the HFB-320 aircraft was investigated Several different modellings of the power spectral densities of the gusts were considered It was shown that the outputs are more influenced than the estimates of the derivatives The best curve fit occurred for modelling of the power spectral densities of the gust by a first order Gauss-Markov process Author

N78-17072# United Technologies Corp Stratford, Conn Sikorsky Aircraft Div
PRELIMINARY DESIGN STUDY OF AN INTEGRATED TAIL ROTOR SERVO POWER MODULE Final Report
Joseph R Maciolek and Karl Wallischeck Sep 1977 165 p refs
(Contract DAAJ02-76-C-0056)
(AD-A047678, SER-50798, USAAMRDL-TR-77-20) Avail NTIS HC A08/MF A01 CSCL 01/3

The purpose of the work performed was to determine the feasibility of generating the hydraulic power required to control the tail rotor pitch of a utility helicopter by locating tail-rotor-driven hydraulic supply systems within the tail rotor servo This relocation of the hydraulic supply system would eliminate the weight, the cost and the excessive vulnerability of the long hydraulic lines in conventional servo systems Using the YUH-60 as a design subject, a preliminary design of an integrated servo power module with electrical (fly-by-wire) inputs was performed This study confirms the advantages of generating the hydraulic power at the tail rotor gearbox When combined with a fly-by-wire controller the weight saving for a UTTAS design would be the order of 10 lbs Compared with the current conventional system, the MTBF of the system would increase by a 7 to 1 factor Production cost savings could be almost $2000 per aircraft GRA

N78-17073# Air Force Inst of Tech , Wright-Patterson AFB, Ohio
AIRCRAFT COMPENSATOR DESIGN METHODS M S Thesis
Tom Lance Riggs, Jr Jun 1977 133 p refs
(AD-A047814, AFIT-CI-77-15) Avail NTIS HC A07/MF A01 CSCL 20/4

In this paper methods using linear analysis are presented for the design of longitudinal flight compensators The compensators employ state feedback to force the aircraft to respond in the desired manner The design process involves analysis of the uncompensated aircraft, construction of a model which has the desired response, and two algorithms for designing the compensator A method is presented for contriving the desired model from handling qualities performance criteria The method is straightforward and results in the exact desired short period response however, the phugoid (long period) response is less predictable The compensator design algorithms are easily implemented into computer programs The algorithms require a minimum of human/computer interaction and solutions are assured for controllable systems Compensators for two aircraft are designed to show the techniques presented In both examples the compensated system response is exactly the same as the model response Author (GRA)

N78-17074# Advisory Group for Aerospace Research and Development, Paris (France)

AN INTRODUCTION TO THE PROBLEM OF DYNAMIC STRUCTURAL DAMPING

Paolo Santini (Rome Univ), Antonio Castellani (Rome Univ) and Alfonso Nappi (Rome Univ) Jan 1978 24 p refs Presented at the 45th Struct and Mater Panel Meeting Voss, Norway, Sep 1977

(AGARD-R-663, ISBN-92-835-1268-5) Avail NTIS HC A02/MF A01

Major topics in the area of dynamic damping are described A list of typical problems where damping is of primary importance is provided Typical structural components are considered and a brief account on the effect of materials is given Mathematical models and intermodal coupling are also examined and the extreme difficulty of obtaining reasonably accurate information from them is emphasized Possible philosophies of ground tests and flight tests are discussed Author

N78-17075# Advisory Group for Aerospace Research and Development, Paris (France)

TECHNICAL EVALUATION REPORT ON THE AVIONICS PANEL/GUIDANCE AND CONTROL PANEL JOINT SYMPOSIUM ON AVIONICS/GUIDANCE AND CONTROL FOR REMOTELY PILOTED VEHICLES (RPVs)

Morris A Ostgaard Dec 1977 14 p Symp held at Florence, 3-6 Oct 1976

(AGARD-AR-113 ISBN-92-835-1264-2) Avail NTIS HC A02/MF A01

A symposium was held to examine the state-of-the-art in the field of avionics and guidance control related to the problems of remotely piloted vehicles Some of the following topics were discussed (1) Electro-optical sensors and their adverse weather capability limitations (2) Experimental testing of various types of sensors (3) Sensor requirements for medium range surveillance and target acquisition systems and (4) Data processing data display systems B B

N78-17076# Advisory Group for Aerospace Research and Development Paris (France)

EFFECTS OF STRUCTURAL NON-LINEARITIES ON AIRCRAFT VIBRATION AND FLUTTER

E Breitbach (Aerodynamische Versuchsanstalt Goettingen, West Ger) Jan 1978 17 p refs Presented at the 45th Struct and Mater Panel Meeting, Voss Norway Sep 1977

(AGARD-R-665 ISBN-92-835-1270-7) Avail NTIS HC A02/MF A01

The physical sources of various types of nonlinearities were examined and their influence on the different parts of the flutter clearance process was investigated Methods which permit quantitative solutions of nonlinear aeroelastic problems were also surveyed Author

N78-17077# Dunlay (William J, Jr) Bala Cynwyd, Pa

AIRPORT IMPROVEMENT TASK FORCE DELAY STUDY DELAY MODEL VALIDATION PLAN Final Report, 26 Jul. - 18 Aug 1977

William J Dunlay Jr Washington FAA Aug 1977 55 p refs

(FAA Order W1-77-2412-1)

(AD-A048112 FAA-EM-77-17) Avail NTIS HC A04/MF A01 CSCL 01/5

A validation plan was presented for an airside simulation model The plan stresses basic principles of validation and inherent problems associated with comparing simulation model delay estimates with observable real-world data A methodology was proposed that consists of three major steps (1) evaluation of model logic inputs, and outputs (2) comparison of model estimates with collected data and (3) a sensitivity analysis of the delay simulation model A Model Validation Group established to oversee the validation process, was described Suggestions were given on sources of data on airside operations for model inputs and for comparisons with model estimates Author

N78-17078# Stanford Research Inst Menlo Park Calif

PILOTED FLIGHT SIMULATOR STUDY OF LOW-LEVEL WIND SHEAR, PHASE 1 Interim Report, Jun 1975 - Jul. 1976

Walter B Gartner and A Charles McTee May 1977 72 p refs

(Contract DOT-FA75WA-3650, SRI Proj 4364)

(AD-A047985, FAA-RD-77-166) Avail NTIS HC A04/MF A01 CSCL 01/4

A piloted flight simulation was conducted to evaluate the need for improved cockpit displays and procedures for aiding airline pilots in anticipating and coping with the effects of low-level wind shear Pilot and aircraft response to the shear encounter under 'baseline conditions was determined using existing cockpit displays and approach management procedures, and the improvement that might be realized from various ways of augmenting the information available to the pilot for wind-shear detection and flight control was evaluated The results indicate that pilots would not be able to successfully cope with the more severe frontal and thunderstorm shears using existing flight instruments and procedures All of the aiding concepts evaluated provided some useful information for alerting the pilot to a potential shear and for indicating the effects of the shear during the encounter However pilot preferences were strongly in favor of a display of ground speed integrated with the airspeed indicator Author

N78-17079# Naval Air Propulsion Test Center, Trenton NJ Propulsion Technology and Project Engineering Dept

EVALUATION OF THE EXTENDED USE OF FERROCENE FOR TEST CELL SMOKE ABATEMENT ENGINE AND ENVIRONMENTAL TEST RESULTS Interim Report

Anthony F Klarman Oct 1977 126 p refs

(AD-A047659, NAPTC-PE-110) Avail NTIS HC A07/MF A01 CSCL 21/4

Results of a test program to evaluate the feasibility of utilizing the smoke suppressant fuel additive, ferrocene during post overhaul performance checks of gas turbine engines at Naval Air Rework Facilities (NARFs) and other lower level maintenance test facilities to reduce test cell exhaust smoke plumes to environmentally acceptable levels are presented This test program was conducted on the following gas turbine engines J52-P-6B, J57-P-10, J79-GE-8D, TF30-P-6C and TF41-A-2A

Author (GRA)

N78-17080# Vehicle Systems Development Corp, Upland, Calif

HELICOPTER GROUND MOBILITY SYSTEM (HGMS) CONCEPT FORMULATION AND SELECTION Final Technical Report, 29 Jun. 1976 - 20 Jun 1977

R W Forsyth and J P Forsyth Sep 1977 94 p refs

(Contract DAAJ02-76-C-0037 DA Proj 1F2-62209-AH-76)

(AD-A047507, USAAMRDL-TR-77-35) Avail NTIS HC A05/MF A01 CSCL 01/3

The first task resulted in the definition of some 30 ground mobility system concepts, including wheeled and tracked, frame-type transporters, auxiliary wheel systems all-wheel-drive prime movers and two-element, articulated mover systems designed for load transfer from the helicopter In Task 2 the contractor developed evaluation criteria and conducted a preliminary analysis of the suitability of the various concepts for the mission of providing local ground mobility for the AAH and UTTAS helicopters in unimproved terrain The third task involved the preparation of prototype design layouts of the selected concept, a four-wheeled two-element articulated prime mover, with provisions for offloading the tail wheel of the helicopter for weight transfer and controls for a walking operator With tractive effort provided by this, the flotation required for the helicopter is achieved by temporarily attaching tracks on the main landing gear of the helicopter Additionally under Task 3, the contractor prepared the system specification for the HGMS The program effort was concluded with Task 4 which involved the development of a concept design and preliminary layout drawings for the adapter unit enabling use of the HGMS with skid-equipped helicopters GRA

N78-17082# Appli-Mation Inc , Orlando, Fla
INSTRUCTOR PILOT'S ROLE IN SIMULATION TRAINING, PHASE 2 Final Report, Mar 1976 - May 1977
John P Charles Aug 1977 59 p refs
(Contract N61339-76-C-0034)
(AD-A047919 NAVTRAEQUIPC-76-C-0034-1) Avail NTIS HC A04/MF A01 CSCL 05/9

Analyses of Instructor Pilot functions in training pilots using simulation were performed The functions were based on the review of current simulation training conducted in the Phase I study NAVTRAEQUIPCEN 75-C-0093-1 (AD-A023 546) Feasible allocations of functions were made and modular implementation concepts developed GRA

N78-17084# Naval Weapons Support Center Crane, Ind
AN EXAMINATION OF SELECTED DIGITAL FLIGHT GENERATORS Final Report, May 1974 - Dec 1975
D K Sanders and N L Papke Nov 1977 49 p refs Sponsored by Joint Tech Coordinating Group for Aircraft Survivability
(AD-A047845, JTCG/AS-77-S-001) Avail NTIS HC A03/MF A01 CSCL 09/2

This report describes the findings of an investigative analysis of four flightpath generation computer models The four models (FAIR PASS FLYGEN BLUE MAX and MCEP) are commonly used in the aircraft survivability/vulnerability community The first three are primarily fixed-wing models, while MCEP is exclusively a rotary-wing flightpath generator All four models were acquired installed tested and analyzed at NWSC (Naval Weapons Support Center), Crane, IN Criteria such as capabilities limitations ease and economy of use and compatibility with attrition models were considered in the evaluations Author (GRA)

N78-17229*# National Aeronautics and Space Administration Lewis Research Center Cleveland Ohio
ALTERNATIVE AIRCRAFT FUELS
J P Longwell (MIT Cambridge) and J Grobman Jun 1977 22 p refs Proposed for presentation at 23d Ann Intern Gas Turbine Conf , London, Engl , 9-13 Apr 1978 sponsored by Am Soc of Mechan Engineers
(NASA-TM-73836) Avail NTIS HC A02/MF A01 CSCL 21D

The efficient utilization of fossil fuels by future jet aircraft may necessitate the broadening of current aviation turbine fuel specifications The most significant changes in specifications would be an increased aromatics content and a higher final boiling point in order to minimize refinery energy consumption and costs These changes would increase the freezing point and might lower the thermal stability of the fuel and could cause increased pollutant emissions, increased combustor liner temperatures, and poorer ignition characteristics The effects that broadened specification fuels may have on present-day jet aircraft and engine components and the technology required to use fuels with broadened specifications are discussed Author

N78-17292 Kansas Univ Lawrence
AN INVESTIGATION OF LIGHTNING DAMAGE TO NON-METALLIC COMPOSITE AIRCRAFT MATERIALS AND ASSOCIATED PROTECTIVE SYSTEMS Ph D Thesis
Steven Ames Lorenz 1977 140 p
Avail Univ Microfilms Order No 77-29190

The inherent dangers of operating aircraft equipped with nonmetallic components within the natural lightning environment are described A philosophy for simulating the natural lightning current waveform is presented and a circuit to produce simulated waveforms is proposed A chronicle of the design construction and operation of a simulation facility based on this circuit is presented with emphasis on design and operational safety aspects A test program using boron/epoxy and graphite/epoxy material specimens is outlined Possible applications and modifications for this type of facility are suggested that are commensurate with the future uses of nonmetallic composite materials in aircraft structures Dissert Abstr

N78-17339*# McDonnell Aircraft Co , St Louis, Mo
EVALUATION OF A LARGE CAPACITY HEAT PUMP CONCEPT FOR ACTIVE COOLING OF HYPERSONIC AIRCRAFT STRUCTURE
L L Pagel and R L Herring Feb 1978 47 p refs
(Contract NAS1-14981)
(NASA-CR-145301) Avail NTIS HC A03/MF A01 CSCL 20D

Results of engineering analyses assessing the conceptual feasibility of a large capacity heat pump for enhancing active cooling of hypersonic aircraft structure are presented A unique heat pump arrangement which permits cooling the structure of a Mach 6 transport to aluminum temperatures without the aid of thermal shielding is described The selected concept is compatible with the use of conventional refrigerants, with Freon R-11 selected as the preferred refrigerant Condenser temperatures were limited to levels compatible with the use of conventional refrigerants by incorporating a unique multipass condenser design, which extracts mechanical energy from the hydrogen fuel, prior to each subsequent pass through the condenser Results show that it is technically feasible to use a large capacity heat pump in lieu of external shielding Additional analyses are required to optimally apply this concept Author

N78-17390*# Stein Seal Co , Philadelphia, Pa
FEASIBILITY STUDY OF NEGATIVE LIFT CIRCUMFERENTIAL TYPE SEAL FOR HELICOPTER TRANSMISSIONS
E N Golding Oct 1977 38 p
(Contract NAS3-20598)
(NASA-CR-135302) Avail NTIS HC A03/MF A01 CSCL 11A

A new seal concept the negative lift circumferential type seal, was evaluated under simulated helicopter transmission conditions The bore of the circumferential seal contains step type geometry which produces a negative lift that urges the sealing segments towards the shaft surface The seal size was a 2 5 inch bore and the test speeds were 7000 and 14,250 rpm During the 300 hour test at typical transmission seal pressure (to 2 psig) the leakage was within acceptable limits and generally less than 0 1 cc/hour during the last 150 hours of testing The wear to the carbon segments during the 300 hours was negligible Author

N78-17398# Air Force Flight Dynamics Lab Wright-Patterson AFB Ohio
INCLUDING FLEET USAGE VARIABILITY IN RELIABILITY ANALYSES FOR BOTH SAFETY AND ECONOMIC LIMIT Final Report, Sep 1976 - Mar 1977
Robert L Neulieb Aug 1977 21 p refs
(AD-A047714, AFFDL-TR-77-77) Avail NTIS HC A02/MF A01 CSCL 14/4

Reliability tools have been developed which are capable of determining the probability of failing a given aircraft or the first aircraft in a fleet as a function of time, loading and inspections These methods developed for the entire fleet can easily be extended to include variations in usage across the fleet and to address the concept of economic life Author (GRA)

N78-17558*# National Aeronautics and Space Administration Lewis Research Center, Cleveland Ohio
AUTOMATED METEOROLOGICAL DATA FROM COMMERCIAL AIRCRAFT VIA SATELLITE PRESENT EXPERIENCE AND FUTURE IMPLICATIONS
Robert Steinberg 1978 7 p refs Presented at Intern Conf on Maritime and Aeron Satellite Commun and Navigation, London, 7-10 Mar 1978 sponsored by Institution of Elec Eng
(NASA-TM-73750 E-9323) Avail NTIS HC A02/MF A01 CSCL 04B

A low-cost communications system to provide meteorological data from commercial aircraft, in neat real-time on a fully automated basis has been developed The complete system including the low profile antenna and all installation hardware weighs 34 kg The prototype system was installed on a B-747 aircraft and provided meteorological data (wind angle and velocity,

temperature, altitude and position as a function of time) on a fully automated basis The results were exceptional This concept is expected to have important implications for operational meteorology and airline route forecasting Author

N78-17598# World Meteorological Organization Geneva (Switzerland)
A DIGITAL CONTINUOUSLY UPDATED TWO MINUTE MEAN WINDSPEED INDICATOR FOR USE AT AIRPORTS
G Venugopal and G P Srivastava *In its* Inst and Methods of Observation 1977 p 91-96 refs

Avail NTIS HC A12/MF A01

A digital average windspeed measuring equipment for use at airports based on the measurement of the total wind run for 2 minute periods continuously updated every 10 seconds is described The quipment consists of a photoelectric cup anemometer for sensing the wind a computer for computing the mean windspeed a programmer to control the computer operations and a seven segment numeric indicator to display the information ESA

N78-17600# World Meteorological Organization Geneva (Switzerland)
A CURRENT WEATHER INFORMATION DISPLAY SYSTEM FOR USE AT AIRPORTS
G Venugopal and G P Srivastava *In its* Instr and Methods of Observation 1977 p 100-104

Avail NTIS HC A12/MF A01

A description is given of the current weather display system in use at Indian airports The system consists of conventional sensors for wind direction, wind speed dew point and air temperature The system electronics comprise an analog multiplexer, and A/D converter a storage and serializer unit as well as the display and power supply ESA

N78-17915*# Gellman Research Associates Inc Jenkintown Pa
THE ROLE OF ENGINEERING IN THE FLIGHT EQUIPMENT PURCHASING PROCESS Final Report
Dec 1977 85 p
(Contract NASw-3075)
(NASA-CR-156839) Avail NTIS HC A05/MF A01 CSCL 05A

The role of the airline engineering department in the flight equipment acquisition process is examined The data for the study was collected from six airlines The principal findings of the study include (1) engineering activities permeate, but do not dominate the airline flight equipment decision process (2) The principal criterion for the flight equipment acquisition decision is return on investment (3) The principal sources of information for the airline engineering departments in the monitoring process are the manufacturers of equipment Subsidiary information sources include NASA publications and conferences among others and (4) The engineering department is the principal communication channel for technical information Author

N78-17921*+ National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio
BIBLIOGRAPHY OF LEWIS RESEARCH CENTER TECHNICAL CONTRIBUTIONS ANNOUNCED IN 1976
Dec 1977 192 p
(NASA-TM-73860, E-9449) Avail NTIS HC A09 CSCL 05B

Abstracts of Lewis authored publications and publications resulting from Lewis managed contracts which were announced in the 1976 issues of STAR (Scientific and Technical Aerospace Reports) and IAA (International Aerospace Abstracts) are presented Research reports, journal articles, conference presentations, patents and patent applications, and these are included The arrangement is by NASA subject category Citations indicate report literature (identified by their N-numbers) and the journal and conference presentations (identified by their A-numbers) A grouping of indexes helps locate specific publications by author (including contractor authors), contractor organization, contract number, and report number Author

N78-17931*# Summerfield Associates Santa Monica Calif
DETERMINATION OF THE FLIGHT EQUIPMENT MAINTENANCE COSTS OF COMMUTER AIRLINES
Nov 1977 37 p refs
(NASA Order A-36079-B(TS))
(NASA-CR-152069) Avail NTIS HC A03/MF A01 CSCL 05C

Labor and materials costs associated with maintaining and operating 12 commuter airlines carrying an average of from 42 to 1 100 passengers daily in a variety of aircraft types were studied to determine the total direct maintenance cost per flight hour for the airframe, engine and avionics and other instruments The distribution of maintenance costs are analyzed for two carriers one using turboprop aircraft and the other using piston engine aircraft A R H

N78-17943# Defense Systems Management School, Fort Belvoir, Va
THE PROBLEM OF TECHNOLOGY TRANSFER REAL OR IMAGINED
Warren W Cook May 1977 52 p refs
(AD-A042961) Avail NTIS HC A04/MF A01 CSCL 05/1

This study project report provides an analysis of the process by which the Air Force transfers or transitions technology from less than major system advanced development projects performed in *Air Force laboratories to use in operational systems An* examination of the DoD and Military Departments policies, procedures and technology base management techniques lead *to a description of the factors that tend to camouflage or provide* roadblocks to the transition process These factors are placed into Communications/Motivation Groups and are evaluated for *their impact on the process Conclusions are reached concerning* the Air Force laboratory organizational structure, use of off-the-shelf hardware, contractor independent research and development, *and contract procedures Recommendations discuss documenta*tion, changes in organizational structure, and modification of procurement and contracting procedures Author (GRA)

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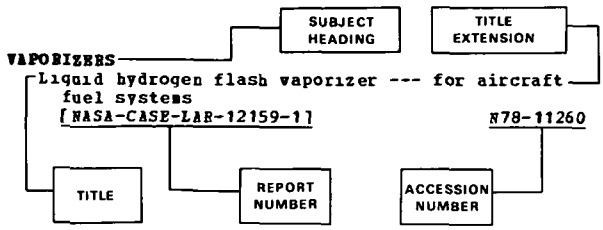

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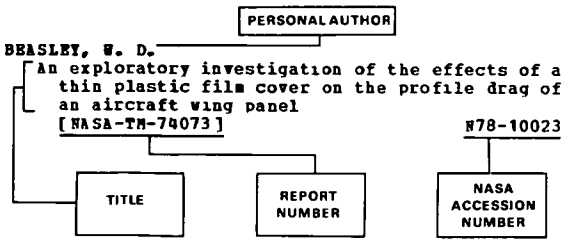

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